# TRANSACTIONS

## AMERICAN ACADEMY
of
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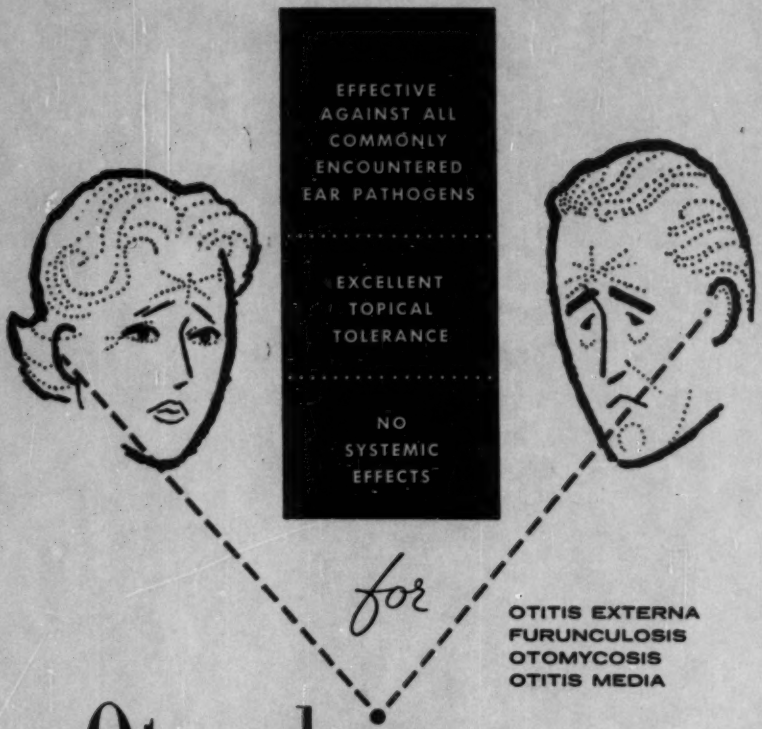
and
## OTOLARYNGOLOGY

JANUARY - FEBRUARY
*1959*

Volume 63 No. 1

ANNUAL MEETING, OCTOBER 11-16, 1959, CHICAGO

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# TRANSACTIONS

American Academy of Ophthalmology and Otolaryngology

VOLUME 63 JANUARY - FEBRUARY, 1959 NUMBER 1

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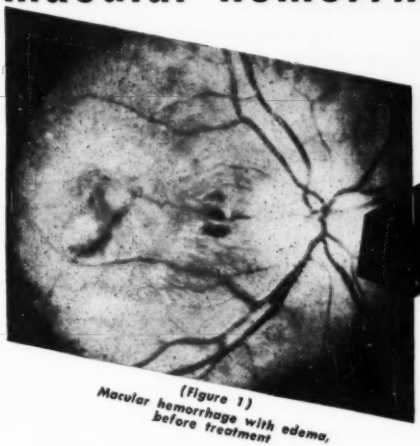
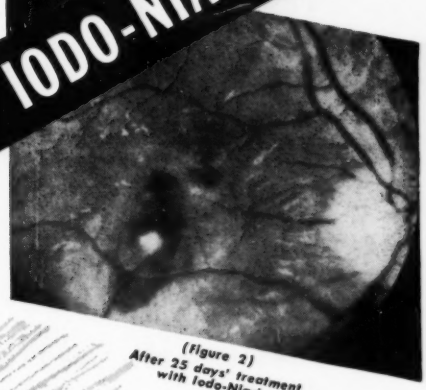
# macular hemorrhages

respond to

## IODO-NIACIN*



(Figure 1)
Macular hemorrhage with edema, before treatment



(Figure 2)
After 25 days' treatment with Iodo-Niacin

Macular and retinal hemorrhages are satisfactorily absorbed after use of IODO-NIACIN[1]. The dosage used in this study was 1 tablet three times daily.

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1. *Am. J. Ophth.* 42:771, 1956.
2. *Am. J. Digest Dis.* 22:5, 1955.
3. *Med. Times* 84:741, 1956.
4. *Cecil's Textbook of Medicine*, 7th ed., 1947, p. 1598.

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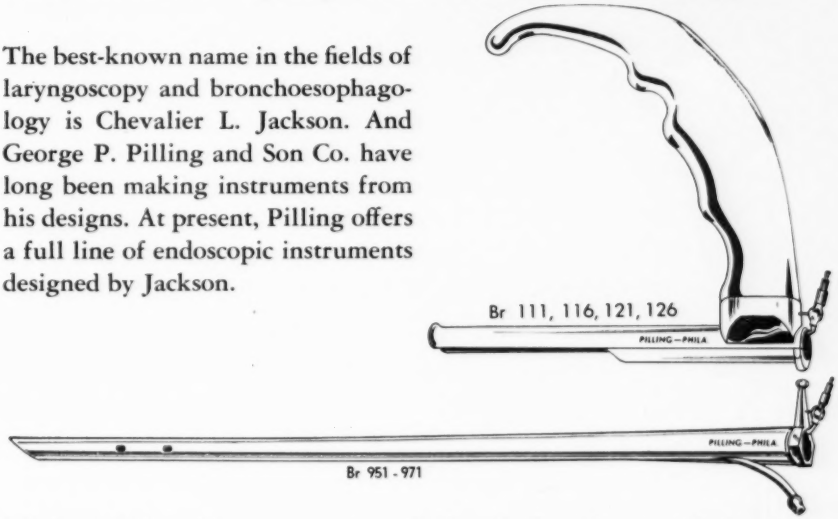


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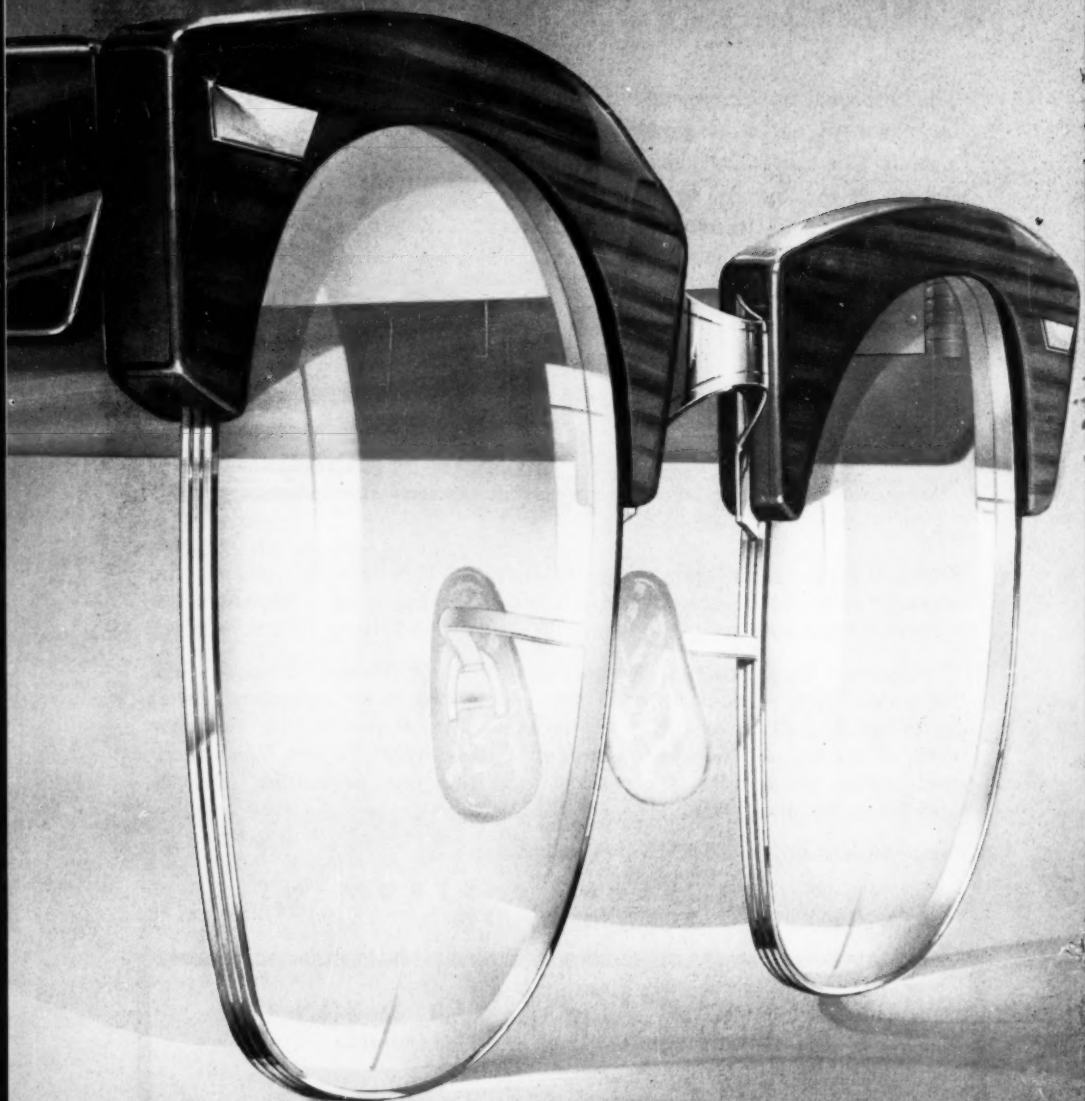

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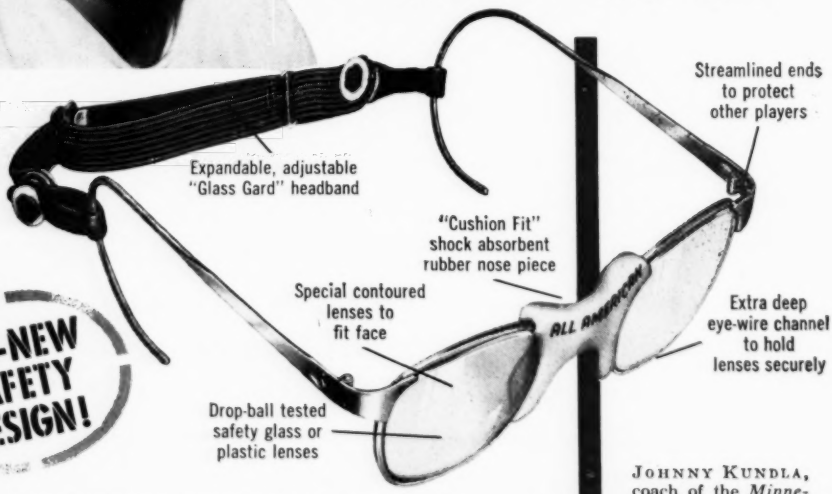
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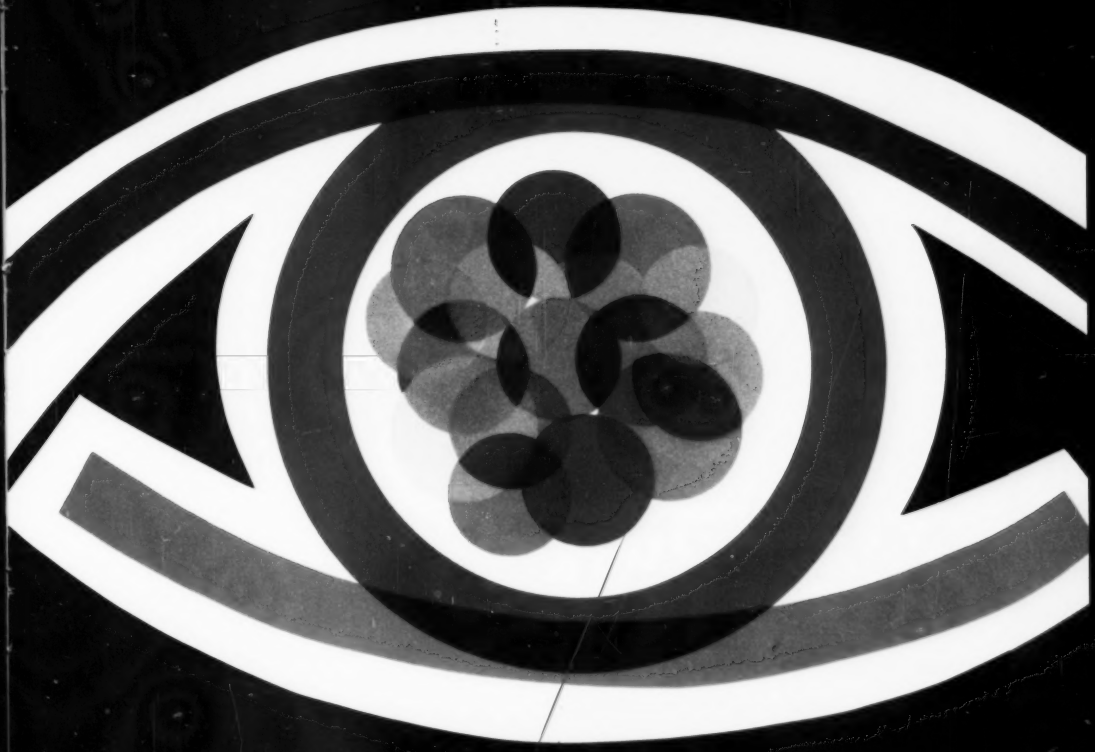

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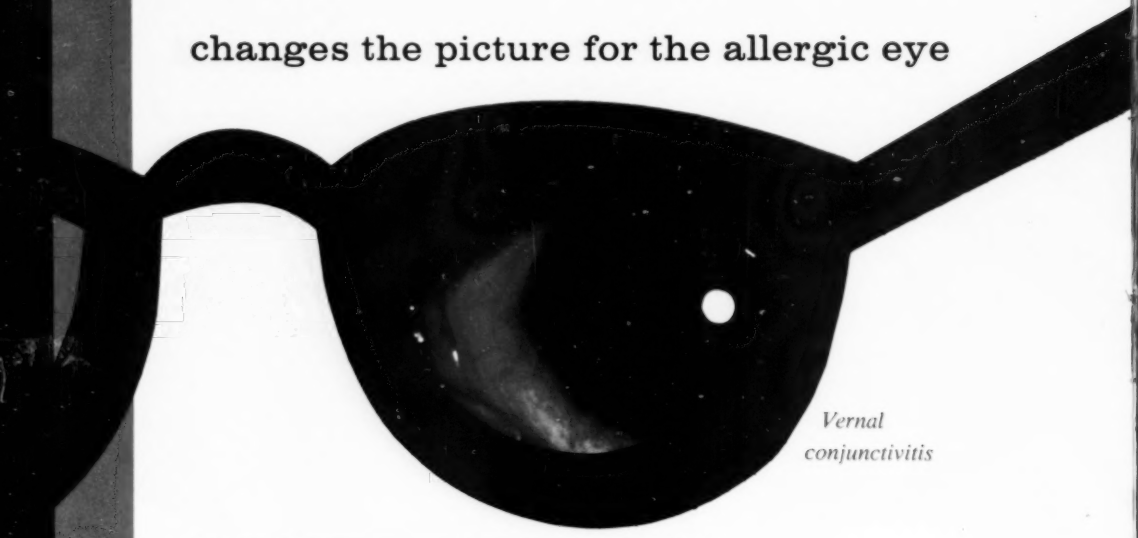

*Vernal conjunctivitis*

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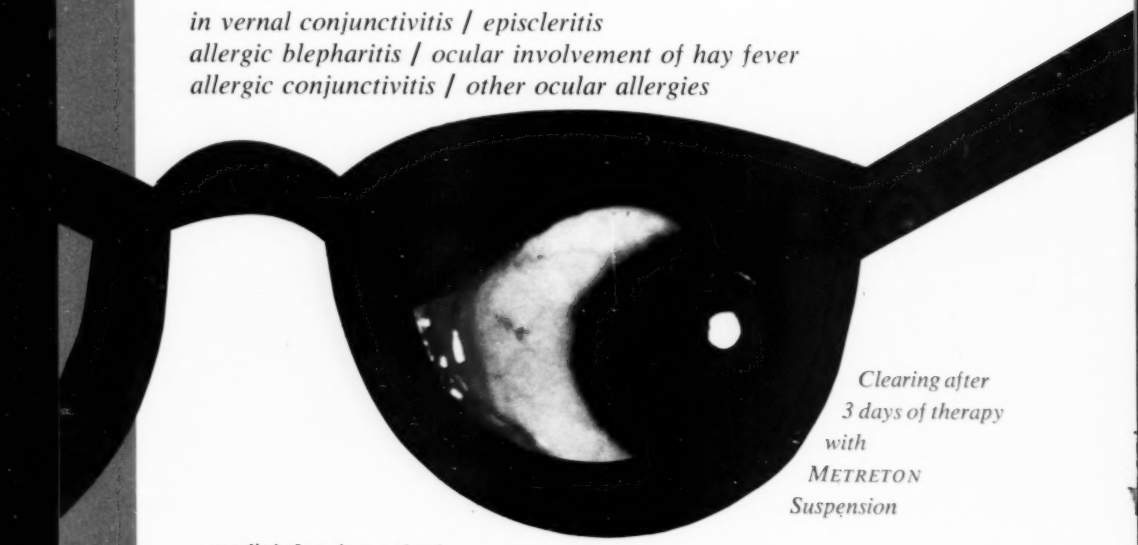
*allergic conjunctivitis / other ocular allergies*



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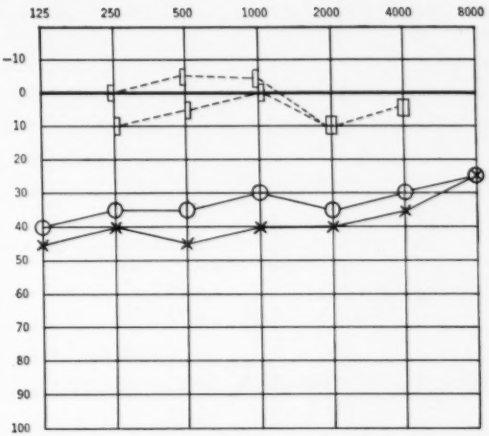


If this were your patient's audiogram, which type of hearing aid would you recommend? It is taken from the case history of a 32-year-old bookkeeper whose hearing loss was diagnosed, at age 19, as otosclerosis, with little or no perceptive component. In consultation with his doctor, the patient decided against surgery.

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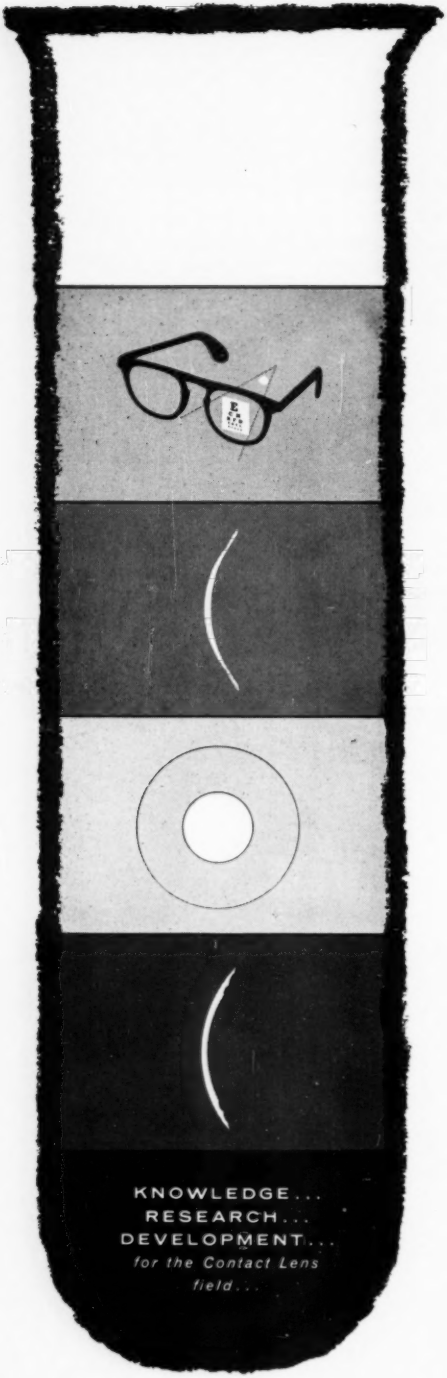


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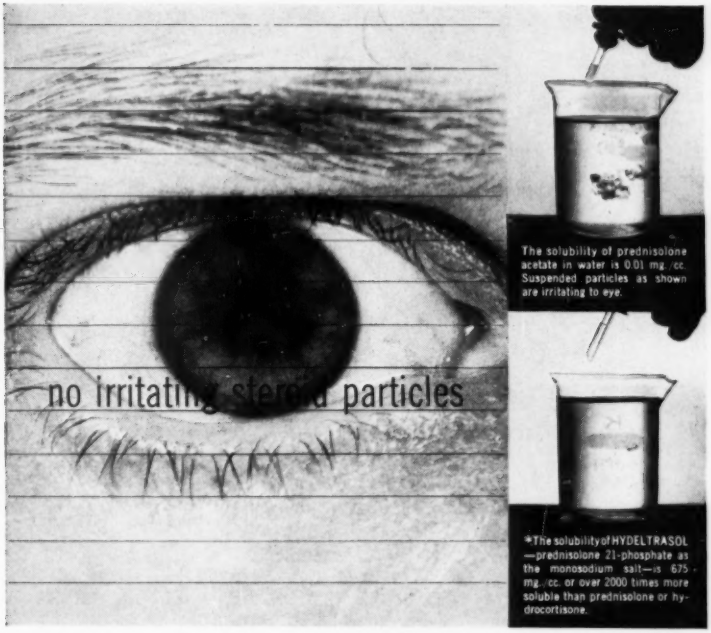
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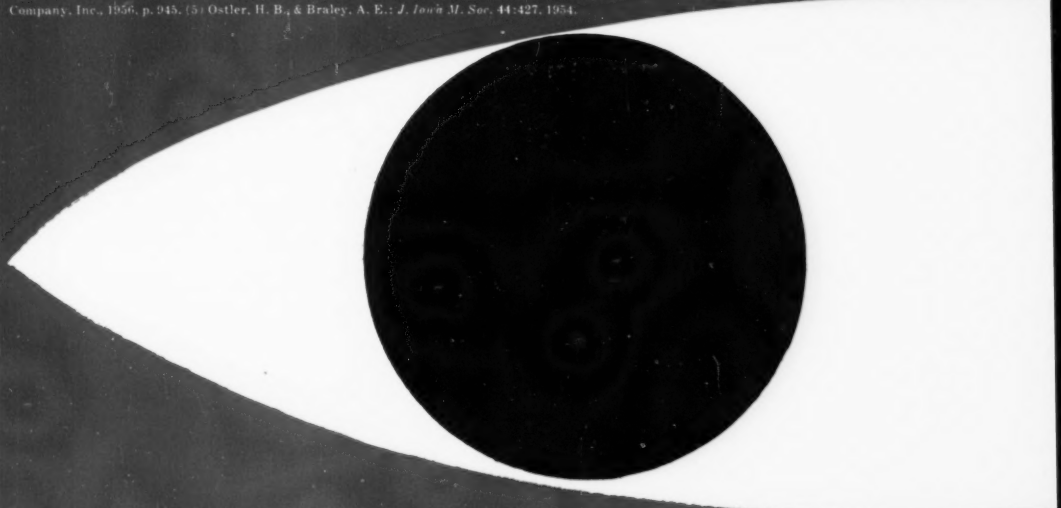
REFERENCES: (1) Perkins, E. S.: *Practitioner* 178:575, 1957. (2) Queries and Minor Notes, *J.A.M.A.* 161:1032, 1956. (3) Smith, C. H.: *Eye, Ear, Nose & Throat Month.* 34:580, 1955. (4) Blakiston's New Gould Medical Dictionary, ed. 2, New York, McGraw-Hill Book Company, Inc., 1956, p. 945. (5) Ostler, H. B., & Braley, A. E.: *J. Iowa M. Soc.* 44:427, 1954.



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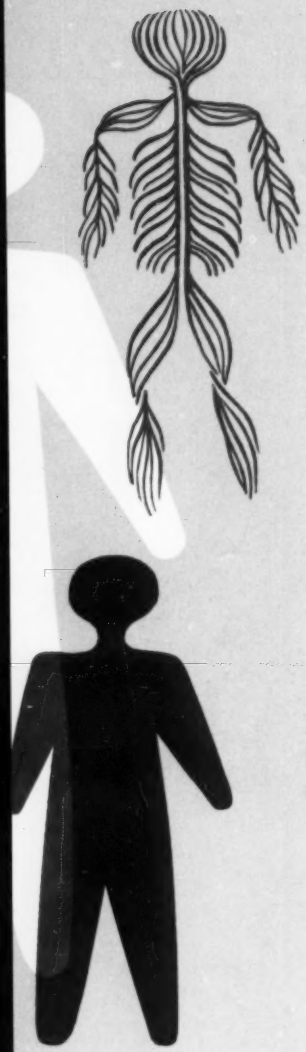

In effective hemostasis—blood clotting is only part of the mechanism

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SALICYLATE

(Brand of carbazochrome salicylate)

## to control oozing and bleeding

Many surgeons and researchers concur that blood clotting is only part of the mechanism of hemostasis. Roskam, in his monograph "Arrest of Bleeding"[1] says "... effective spontaneous hemostasis is undoubtedly achieved by the combined action of at least three processes: (1) the formation of a white thrombus at the mouth of vascular wounds; (2) the coagulation of the blood; (3) the contraction of injured arteries and veins."

Another study points out that "The majority of tonsillo-adenoidal hemorrhages are due to a defect of the vascular bed, rather than to a coagulation defect."[2] This study recommends that Adrenosem be used both preoperatively and postoperatively to maintain vascular integrity.

A current review concludes: "The data assembled over a four year period bearing on the use of Adrenosem salicylate in the control of hemorrhage from the nose and throat warrant the following conclusions. The routine preoperative use of this drug in tonsil and adenoid surgery reduces bleeding at the time of operation and oozing in the immediate postoperative period. As a result the operating time is reduced and fewer patients require suture of the tonsil fossa to control bleeding."[3]

Adrenosem controls bleeding and oozing by decreasing capillary permeability and by promoting the retraction of severed capillary ends. These actions are of prime importance in achieving effective hemostasis.

Adrenosem is supplied: Ampuls, 1 cc., 5 mg.; Tablets, 1 and 2.5 mg.; Syrup, each 5 cc., 2.5 mg. Potency of all dosage forms stated in terms of the active ingredient, adrenochrome monosemicarbazone.

*U.S. Pat. 2581850, 2506294


1. Roskam, J.: Arrest of Bleeding, Charles C. Thomas, Springfield, Illinois, 1954.

2. Coyle, J.E.: Analysis of Blood and Vascular Factors in the Prophylaxis of Tonsillo-Adenoidal Hemorrhage, Laryngoscope, 10:1029 (Oct. 1957).

3. Peele, J.C.: Control of Hemorrhage from the Nose and Throat, Med. Times, 10:1228 (Oct. 1958).


*Write for literature describing the action and uses of Adrenosem Salicylate.*

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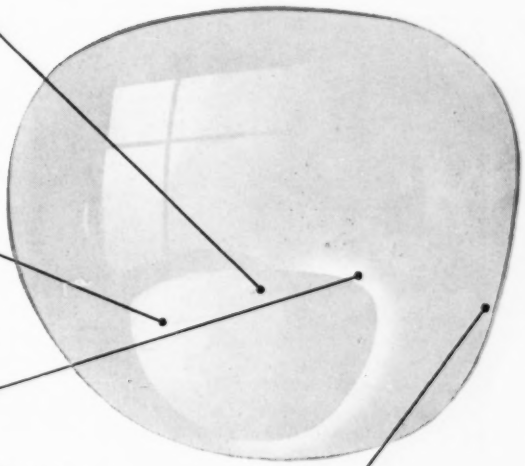

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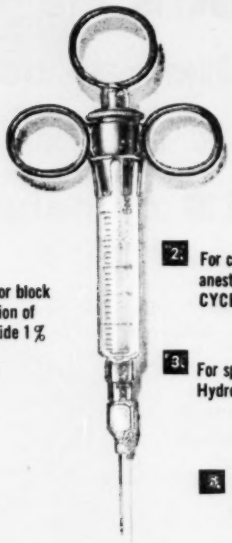

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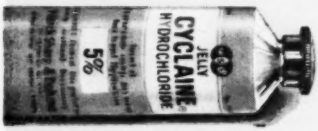


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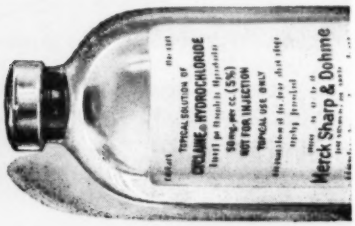


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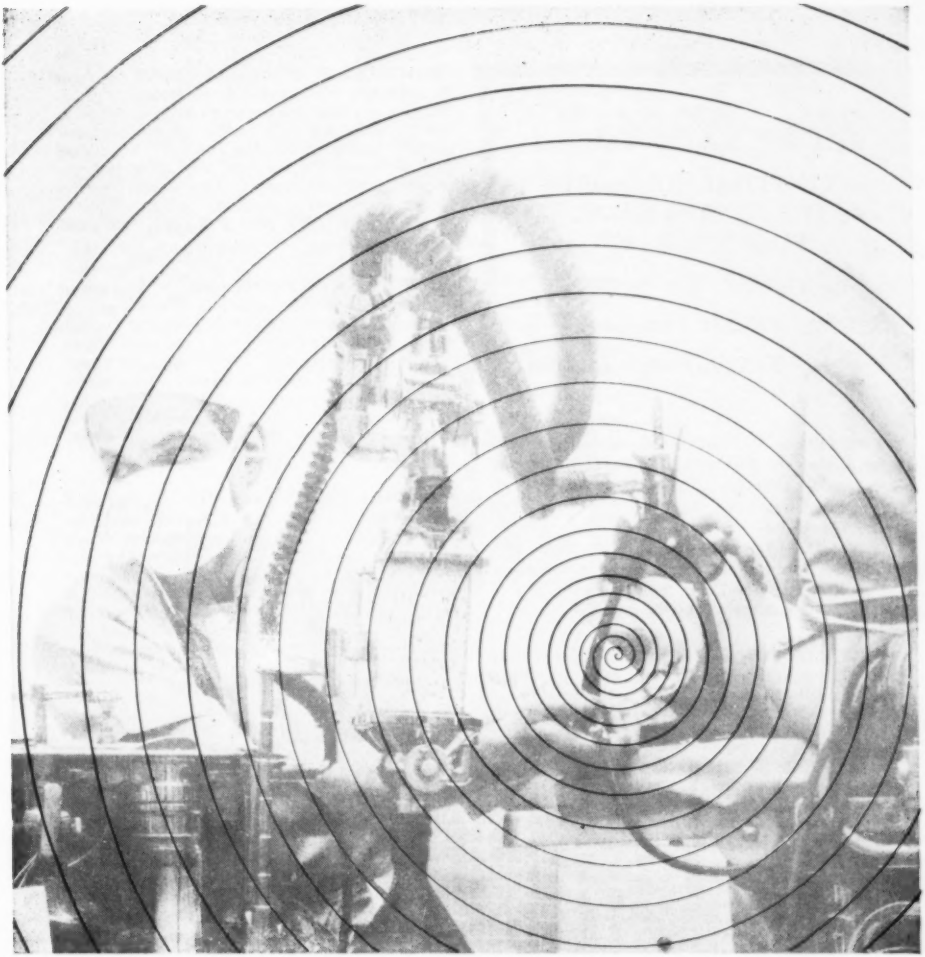

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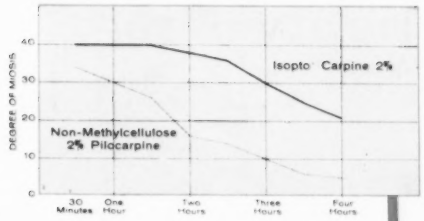


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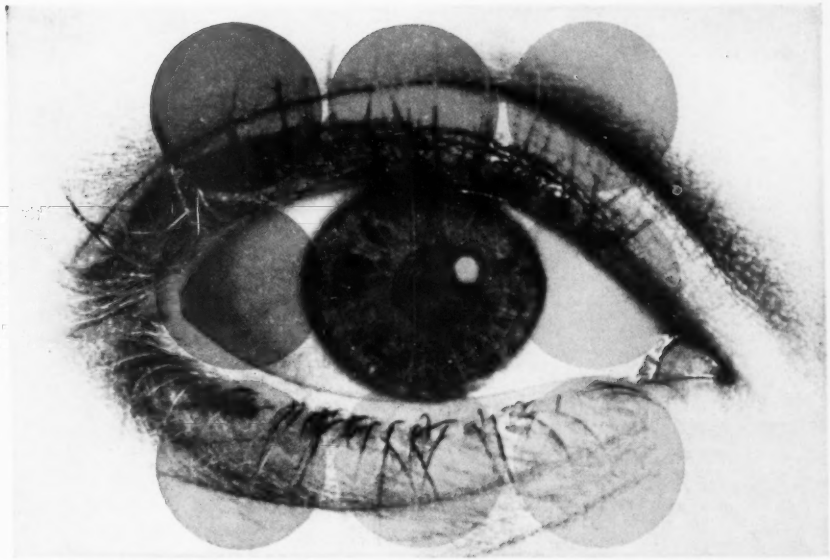

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1. New and Nonofficial Drugs; J. B. Lippincott Company, Philadelphia, 1958, p. 243.

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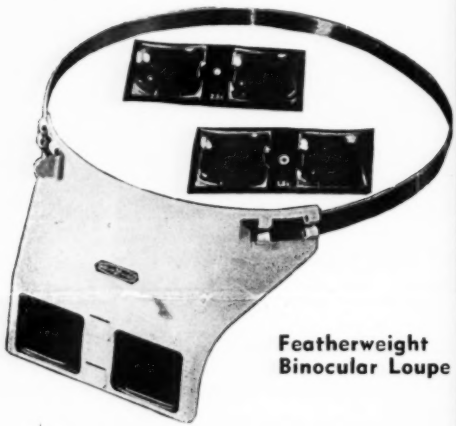

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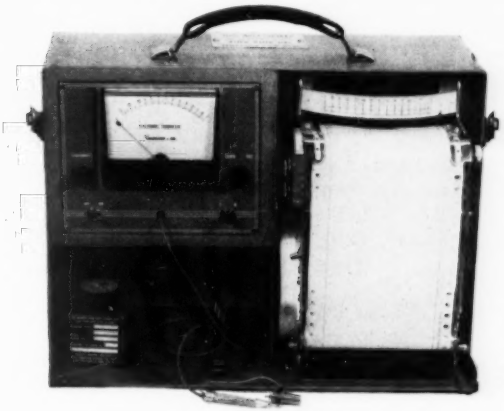

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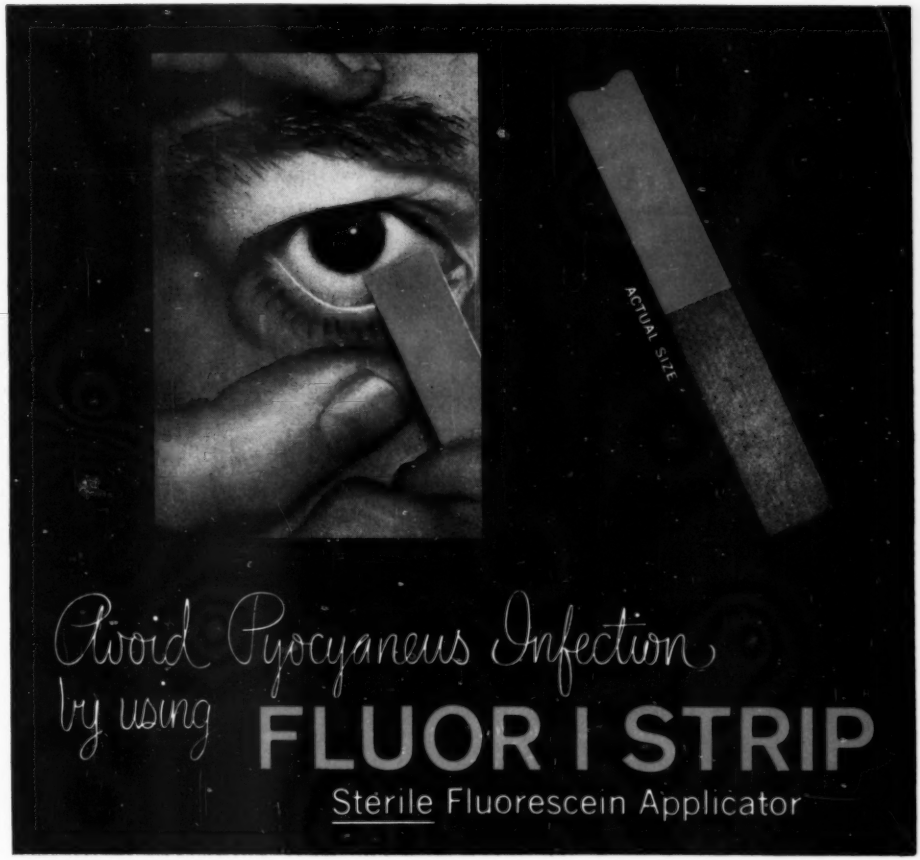


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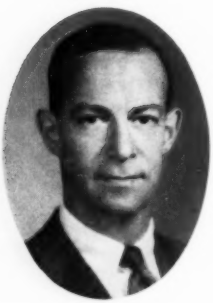

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*Address of the President*

* * *

# SCIENCE KNOWS NO FRONTIERS

LeRoy A. Schall, M.D.
BOSTON, MASSACHUSETTS

As President of the Academy, I have the honor to bid you welcome to the Sixty-Third Annual Session. I trust you will take full advantage of the scientific programs, the instructional courses and the various activities that will take place during the coming week.

May I express to the Academy my appreciation of the honor you have bestowed upon me. To be President of the Academy, an organization of over 6500 members, and to be enrolled in the company of distinguished men who have served as your President is indeed a great privilege and honor. I can only say "Thank you."

To the hard-working Secretary-Treasurer, to the Board of Secretaries, to the Members of the Council, I am indebted for their guidance and for their support.

The presidential addresses of my predecessors have dealt with many subjects — all excellent subjects. The past, the present and the future of the Academy — medical education, both undergraduate and postdoctoral — the changes in the world of medicine, scientific discoveries, the surgical approaches to specific problems and the unsolved problems in our specialties are all recorded in the annals of our Academy.

I will depart from the pattern set by my predecessors. My address will not be scientific, nor will it be distinguished. I know it will be a relief to some of my colleagues to learn that I am not going to discuss the residency training program in otolaryngology.

During the past years it has been my great privilege to visit other countries, in Central America, in South America, in Europe and in Asia. It has been my privilege to speak to the otolaryngologists of these countries. I have been impressed by the scientific knowledge, by the high ethical standards, by the excellent medical care of the patient practiced by these physicians. In my informal talks, at dinners and at banquets, I have stressed the thought that we have a common meeting ground, that disease knows no race, creed or color. If Stevenson was right in his beautiful tribute to the "Physician," if he was right in saying that the physician is "the Flower of our civilization," then from our common meeting ground, there should emerge a mutual understanding, a mutual respect, and a brotherhood of man that should help us to understand one another.

Dr. Gunnar Gundersen, in his president's address to the American Medical Association, expressed the same thought much more clearly when he said:

> Physicians alerted here and abroad can do much to advance the cause of freedom and human well being, for medicine, by its very nature, speaks a universal language dedicated to scientific truth, humanitarian service, individual dignity and world peace. In medical science there are no secrets, no iron curtains, no cold war. To physicians everywhere, atomic energy means a new way of fighting disease, not a new way of conquering the world. Medicine exists to save life, not destroy it.

Presented at the Sixty-Third Annual Session of the American Academy of Ophthalmology and Otolaryngology, Oct. 12-17, 1958, Chicago.

Because of our geographic position, we have not mingled with the peoples of other countries. Until recently we have been isolationists with little understanding for those of other lands. We have been a one-language nation. Many nations of this earth are bilingual and multilingual.

My travel agent recently told me that the most common complaint that he hears from tourists for whom he arranges tours to Latin America is that all they hear is Spanish. Apparently they do not know that in almost every country in South America, English is taught in the grade schools and in the high schools—that the children in these countries can read and write English although, from lack of opportunity, they may be deficient in speaking it.

I am most happy to count over sixty members of this Academy from countries other than our own and Canada. This, I think, is healthy, and I would like to see more members from foreign lands.

Last November at a dinner meeting of otolaryngologists in Tokyo, Dr. Toschi Ishii of Yokohama made a perfect after-dinner speech, a speech of only four words, when he said, "Science knows no frontiers."

We have lived through an age of great technical and scientific discovery. In grade school I studied by a kerosene lamp; in high school by gas light; in college by the electric light. We have seen the coming of the automobile, of the airplane, of radio and television. In my youth the telephone was a curiosity, and Edison's gramaphone was an instrument of wonder.

When I was 7, I had diphtheria; in my teens, typhoid fever; and during my intern days, a perforated typhoid ulcer was a common surgical emergency.

Today diphtheria is rare; typhoid fever is practically unknown except in a few areas; malaria is no longer the killer it once was. The antibiotics have altered the course of the infections, and poliomyelitis appears to have been conquered. The science of medicine has made great progress in the fight against disease. In your lifetime and in mine we have seen scientific and medical advances undreamed of in our youth.

In the recent book, "The Century of the Surgeon," the mythical Dr. Hartmann was in the amphitheater of the Massachusetts General Hospital on the morning of October 16, 1846, when Morton administered sulfuric ether to Gilbert Abbot and Dr. John Collins Warren removed a tumor from the neck. He was in Edinburgh when Dr. James Young Simpson first used chloroform. He made ward rounds with Semmelweis, first at the Vienna General Hospital and then at Budapest. He was with Koch in Germany, with Lister in Glasgow, and with Pasteur in France. Medicine has been enriched by all nations and by all races.

Last October we were rudely shocked and made to realize that "science knows no frontiers" when Sputnik I roared into orbit. Our complacency—military, scientific, and technologic—was utterly destroyed. An examination of our educational system, particularly our scientific educational system, has kept our educators busy and our college presidents explaining to their Boards of Governors.

We in the medical sciences must realize that there is still much to learn. We are pleased that the Academy recognizes its role in sponsoring research activities.

A subcommittee of the Committee on the Conservation of Hearing—a group concerned with research in otolaryngology—held its second annual meeting last Saturday at the University of Chicago. The program was excellent. It was a program on fundamental research. You will be pleased to learn that this group

will operate in the future as a Council committee on research in otolaryngology. This is a healthy indication of the Academy's interest in research.

It has been said that more books can be written about what we do not know than about what we do know. There are many unsolved problems in otolaryngology, and I have been informed there are just as many in ophthalmology. There is a vast area for exploration in fundamental physiology. The biochemist, the electronic engineer, the biophysicist, the neuroanatomist, all can help us in our search for knowledge.

Until we have solved the problem of the common cold, until we have learned the mystery of the allergic states, until we have relieved the mental suffering of the deaf, until we have eradicated neoplastic disease, we have work to do — much work to do.

Science knows no frontiers, and we need more pioneers on these frontiers.

*Address of the Guest of Honor*

* * *

# RETIREMENT

LOUIS H. CLERF, M.D.
ST. PETERSBURG, FLORIDA

I AM happy to be here today as the Guest of Honor of the American Academy of Ophthalmology and Otolaryngology, an organization which I long have held in the highest esteem and in which I have enjoyed Fellowship for one third of a century. I am grateful to our President, Dr. Schall, who selected me for this honor. It has been my privilege to enjoy his friendship over many years and I always have admired him for his attainments in the field of otolaryngology, his interest in medical education and research and his many fine personal qualities.

Having attained the distinguished age of three score years and five in 1954, I had no choice but to divest myself of academic robe and administrative garb and prepare for a less active life. I had acquired early in life the habit of working. Prior to this mandatory discontinuance of certain professional activities there had been no concerted effort on my part to break myself of this habit. Work is not always required of man. There are altogether too many who work without living. There is such a thing as sacred idleness, the enjoyment of which is fearfully neglected.

The selection of the title for this discourse should excite no undue surprise. Familiarity with subject matter to be presented always has been a *must* in the Academy's Instructional Courses. As I am now completing my fourth year of residency in Retirement I feel qualified to make observations on this assignment.

Retirement is an extension of life with a specific beginning. One therefore retires *to* rather than *from* something. One should begin planning early and carefully for successful retirement. This is important from the standpoint of future economic needs and it may be desirable to secure professional aid in this field. The advice of friends is almost always a liability. No one can tell you how to retire or what to do. You may wish to live in semiretirement, seeing fewer patients, curtailing surgical work and finally go into complete retirement when your physical condition will no longer permit even limited practice or when your patients begin to question your medical competency. This method has merit. There are few adjustments to be made. When retirement is complete and when one changes one's home base for health reasons or other reasons the entire problem requires more serious consideration.

Any person's own quiet wisdom, a knowledge of his own likes and dislikes and his aspirations are fairly reliable guides, particularly if the matter has been under consideration for sometime. Sudden retirement, like a shotgun wedding, does bring matters to a rapid final conclusion but it may provide many insoluble problems for the future. It is difficult to adjust from an active life in medicine where one lives by the clock to a life where alarm clocks have only

Presented at the Sixty-Third Annual Session of the American Academy of Ophthalmology and Otolaryngology, Oct. 12-17, 1958.

sentimental value. The overworked tired physician who stated that on retirement "all he wanted to do was sit on the back porch, do nothing and do it slowly" will be very unhappy when he is rested. Rest is valuable only so far as it is a contrast. Prolonged rest leads only to restlessness.

Recreation is important at all ages but it is imperative for one who is retired. The younger physician therefore should cultivate a number of avocations to satisfy his physical, cultural and intellectual needs and these should be pursued as actively as his time will permit. He then will arrive at retirement with a number of uncompleted projects which, although dormant for many years, may be revived and pursued with increasing enthusiasm. Recreation cannot be prescribed. Sports, games, hobbies and travel are the common forms and there should be interest in more than one. Some form of activity is as much a necessity to man as sleeping or eating. Even those who do nothing that can be called work still believe they are doing something. The world has not a man who is an idler in his own eyes. Success in getting enjoyment out of life is to enjoy the things that one is doing. Audubon spent hours watching and recording the activity of birds—that was his vocation. It can be enjoyed equally as an avocation. Such an activity should include an interest in photography and travel.

In the field of retirement every molehill must be viewed as a mountain. Details should become major projects. The trivial things of daily life must assume great importance. The morning paper which consisted entirely of headlines to be read hurriedly on the way to the office now can provide much interest if one learns to read the finer print. Television which provided an opportunity to see an occasional sporting event can be a fine diversion if approached philosophically. I now know and have observed graphically the physiologic actions of aspirin, Bufferin and Anacin and more fully appreciate the advantage of one over the other. I have learned the reason for the slow increase in population of certain of our western states. It is difficult to replace the 50 to 100 able bodied men who are killed nightly in the Westerns. This does not include the Indians. I am presently engaged in a project to explain how one can shoot eight to nine times with a six shooter without reloading.

It was believed that complete retirement was injurious to health. Surveys have indicated that it not only does not injure health but under certain conditions is beneficial. Freedom from long hours of work, the absence of daily tensions and the strain of fighting traffic and the change from a rigorous to a more pleasant climate all tend to be beneficial. One of the ironies of our time is that a khaki-attired auto mechanic can tell us if our car can make a thousand mile trip or whether it will hold together for a few additional years, but the white coated specialist cannot assure us that we will live until tomorrow. Retirement does not affect insurance rates but actuarial data indicate that the average retiree is receiving an annuity and no longer pays premiums.

One of the problems of the retired physician differs from those of others on the retired list. It is purely psychologic but must not be ignored until one is properly adjusted. During his professional life the physician always was addressed as "Doctor," he enjoyed many curbstone consultations, his advice was sought, and his recommendations usually were carried out. In retirement he may be deferentially addressed as "Doc," but the majority of his friends will exhibit a total indifference to his professional attainments. It will be necessary in order to satisfy his ego to become proficient in avocational fields.

If you are interested in horticulture, secure a 25 cent manual on the subject, wear a broad brimmed hat, preferably straw, with a gay band, a gaudy shirt and, strolling about your plot, inspect the shrubs and trees with a critical eye. This attitude will soon establish you as an authority on plant life and curbstone consultations with neighbors and passersby will soon take up much of your free time. If your interest is fishing, a narrow brimmed khaki hat with small bits of fishing gear, preferably hooks, attached to it, will attract more inquirers than fish. If you live at the seaside by all means wear a yachtman's cap at a jaunty angle. Carrying a pair of binoculars and spending much time searching tree tops and hedges has gained for many a reputation as an ornithologist and possibly an official post with the Audubon Society.

A majority of retirees are presumed to be wealthy. If you have not talked too much, this illusion can be continued by spending some time in a stockbroker's office watching the big board, resting and probably catching up on sleep. Some will conclude that you are a member of the firm of Doolittle and Sitmore, but everyone who sees you there will know: You've got it. I realize that one cannot become proficient in all of these fields. I am convinced, however, after a lifetime in the practice of his specialty no physician will be at a loss to give a reasonably comprehensive and satisfactory answer to any query addressed to him and he soon will enjoy his usual prestige in the community.

If you are planning to retire, do not delay too long. Do not retire to the invalid's couch or to the confines of a nursing home. Do not wait for the drifting snows of winter to close in. The autumn of life is a more pleasant season with the leaves falling like our years, the clouds fleeting like our illusions, the sunlit days diminishing like our memories.

Mr. President, may I again express thanks for honoring me. I always shall remember as I stroll along the path of life, that on this happy occasion you have strewn it with the golden and russet and scarlet leaves of autumn marking the end of a fruitful summer.

*XIV Wherry Memorial Lecture*

# PRINCIPLES USED IN THE DEVELOPMENT OF MODERN TEMPORAL BONE SURGERY

JULIUS LEMPERT, M.D.
NEW YORK, NEW YORK

MODERN otology has its origin in the eighteenth century. The first attempts were made to articulate principles to guide the ear surgeon. In the light of later learning we see that some of the precepts of that day were not correctly formulated, nor were they clearly understood or applied. Surgical practice of that time included principles we now know are incorrect and those to which we still adhere. Even those views which later proved erroneous, however, had their place in the development of aural surgery and will be discussed briefly.

## EIGHTEENTH CENTURY

Jean Louis Petit, working in France in the 1750's, had operated successfully for suppurative mastoiditis by trephining the mastoid process. It was confirmed in his published papers (which, however, came out after his death) that he understood the important principle that purulent inflammation of the mastoid is the only indication for surgical intervention.

If this important point was known to other otologists of that day, it was overlooked; it was not applied by the many surgeons who, some 20 years later, adopted the so-called "Jasser operation." Jasser, a Prussian military surgeon, working in the 1770's, found by accident that rupture of the drum in an infected ear and spontaneous escape of fluid improved a patient's hearing. He thereafter advocated an opening in the mastoid for improvement of hearing! Evidently he and some of his contemporaries believed that deafness could be alleviated by establishing a pathway to the middle ear through a perforation in the mastoid process (misinterpreting the importance of drainage of pus to permit sound to enter the middle ear through the mastoid antrum). The "Jasser operation" became widely used as a means for curing deafness. Its misapplication caused many unfortunate results. The most notable, of course, was the case of Baron von Berger, Danish court physician, upon whom the "Jasser operation" was performed in 1791 and who died of meningitis some days after this surgery.

Following the reports of the Berger incident, aural surgery received a setback which took many years to overcome. By the end of the eighteenth century it had been temporarily forgotten, not to be revived until more than a half century later.

## NINETEENTH CENTURY

The early years of the nineteenth century produced many distinguished otologists. Otology was becoming recognized as a separate branch of medicine. The more important developments were not in surgical treatment of the ear, although contributions to knowledge of the anatomy and physiology of the ear provided a firm background for further advances

From the Lempert Institute of Otology, Lempert Research Foundation, Inc.

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in surgery. (Cotugno had described the complexity of the inner ear and it was known that the labyrinth is filled with fluid.) Virchow became world-famous for his studies of pathology; Helmholtz formulated his theories of sound transmission which were to become so vital to the field of otology. Advances in bacteriology by Pasteur, in antisepsis by Lister, and the introduction of anesthesia all played an important role in the firm establishment of aural surgery.

In England, Joseph Toynbee, one of the great pioneers in scientific otology, was engaged in his dissection of temporal bones, and recorded his findings in his book, "Diseases of the Ear," published in 1860. To ensure that his descriptions would be as exact as possible he dissected more than 2,000 temporal bones. He showed how to remove the temporal bone, and compared morbid appearances with symptoms noted during life. Meanwhile, in Ireland, William Wilde, the first true "ear specialist," described the mastoid incision which came to be known as the "Wilde incision." It was widely used and made him famous. Although it was based on erroneous anatomic and surgical knowledge, still its long popularity seems to have helped in keeping alive the practice of mastoid surgery. It was long after Wilde's day, of course, that this important maxim became accepted: In any case in which the "Wilde incision" might be indicated, a mastoid operation is absolutely essential.

Among the more outstanding advances made in the nineteenth century were von Troeltsch's contributions in Germany. In a detailed paper published in 1861, he gave a precise description of his mastoid operation and its indication. He wrote:

> One of the fundamental principles of surgery, which is slowly gaining ground in internal medicine as well, demands that every collection of pus in the tissue should be evacuated externally as soon and as completely as possible. In this way only can damage to neighboring structures, gravitation abscesses, and extension of inflammation be avoided.

It is difficult to understand why aural suppuration was not considered an indication for surgical intervention prior to von Troeltsch's time. Otologists before that relied on perforation of the mastoid cortex and merely hoped for drainage, whereas surgical intervention for pus accumulation in other parts of the body was becoming an accepted procedure.

Von Troeltsch's article gained wide attention and in the next few years a number of other surgeons contributed papers to the literature on mastoid surgery, indicating complete acceptance of von Troeltsch's views. In 1868 Jacoby, an internist in Breslau, commented that "before long the operation of perforation of the mastoid will be adopted as the treatment of specially obstinate middle-ear suppurations, even when no urgent symptom of retention of pus is present." In 1873 Schwartze's reports of his early cases of trephining the mastoid process were published. At first he had used a perforator but then discarded this in favor of chisel and hammer.

The late 80's brought further significant advances in mastoid surgery, on which the present day mastoid operation is still based. Augmenting Schwartze's work, Küster advocated "opening up the bone freely so that it can readily be scrutinized to clear away all disease and fully expose the source of suppuration." Zaufal, in 1894, wrote that he had been led by Küster to adopt removal of the posterior wall of the meatus and he gave a detailed description of seven steps in his procedure. In 1897 Stacke's book, "On the Operative Exposure of the Middle Ear Cavities," appeared. In Stacke's operation the attic is opened by chiselling away the pars epitympanica

and passing a probe into the antrum, thus opening the cavity from the meatus and the external wall. He removed the malleus. By the end of the nineteenth century the principles of modern mastoid surgery, based on Schwartze's operation, as modified by Stacke, became the model for mastoid surgery for otherwise incurable chronic middle ear suppuration.

No résumé of temporal bone surgery in the nineteenth century would be complete without the name of Adam Politzer. Working in Vienna, he became internationally famous for his contributions to the field of otology. Among his chief original additions to treatment of ear diseases was his method of inflation of the middle ear ("politzerization") which is now largely abandoned; but his description of the intracranial and other complications of otitic diseases was of lasting assistance to ear surgeons.

Politzer's outstanding publications included the famed "Otoscopic Atlas" and his book on diseases of the ear, which became a classic and is still counted one of the most important works on the ear ever to be printed. His monumental two-volume "History of Otology," almost encyclopedic in scope, is an invaluable part of the literature on the ear. It is perhaps less well known in the United States than it deserves to be, since it has not been translated into English. The volumes cover comprehensively the entire history of the anatomy and physiology of the ear and of physics of sound and hearing up to the year 1911.

The most significant of Politzer's contributions, however, was his role as a teacher. As the first professor of otology at the University of Vienna, beginning in 1870, he drew to his clinic physicians from all over the world. Over 7,000 postgraduate students attended his classes, which he taught equally well in German, Italian, French or English. The roster of names of his students reads like a "Who's Who in Otology." It includes among other respected otologists: Neumann, Ruttin, Leidler, Alt, Barany, Gradenigo, Lucae, Lermoyez, Alexander, Panse, Denker, Hartmann, Bezold, and dozens of other Europeans. Politzer can be credited with having lasting influence on the development of otology in the United States also, for it is certain that Clarence Blake of Boston, one of the great American otologists, was indebted to Politzer, to whom he served as assistant in Vienna. Another outstanding American otologist, Gorham Bacon of New York, was also a Politzer pupil.

The last decade or so of the nineteenth century saw the introduction of another phase of temporal bone surgery. This was attempted mobilization of the stapes, a surgical process that occupied otologists in Europe and the United States in the closing years of this century.

In order to indicate the rationale for attempted mobilization of the stapes as a means for restoring hearing, prior to the 1890's, it is necessary to look back for a moment to the eighteenth century. Ankylosis of the stapes had been mentioned by Valsalva as early as 1735. Morgnagni, in 1766, also mentioned a case in which the fenestra ovalis and the base of the stapes formed a solid bony plate; Meckel, in 1777, described one in which the membrane connecting the base of the stapes with the fenestra ovalis had become bony. Toynbee, in 1841, was among the first to make a distinction between bony and membranous ankylosis on the basis of pathologic findings in his dissections of temporal bones. Schwartze, in 1870, also demonstrated in a number of autopsied temporal bones from persons known to be deaf during lifetime, that stapes ankylosis was the cause of the hearing loss. Schwartze credited von Troeltsch with the term "sclerosis" resulting in ankylosis of the stapes. Bezold (1885), Gradenigo (1887) and Politzer (1882) all described stapes ankylosis, resulting either from adhesion

of the footplate to the margin of the oval window or by attachment of the crura to the lower wall of the niche of the oval window.

In 1891 Haberman reported pathologic findings in a postmortem case, and in 1897 Panse recapitulated the findings of the foregoing investigators. He had studied the temporal bone collections of Toynbee, Politzer and Haberman, and published a monograph in which he maintained that the stapes and the round window are the most important parts of the sound conduction chain; that rigidity of these structures is usually the cause of hearing loss.

Accepting stapes ankylosis as a proved cause of deafness, Kessel, as early as 1876, had recommended that the tympanic membrane, the incus and malleus be removed if the ankylosis was the result of suppurative processes. It was Kessel who also suggested that if attempts to mobilize the incudostapedial joint or footplate of the stapes are successful without disrupting the ossicular chain, then improvement of hearing in cases of "sclerosis" may be expected.

In 1888 Boucheron reported on 60 patients operated on for mobilization of the stapes, the operation consisting of separation of the incus from the stapes, excision of the posterior half of the tympanic membrane, mobilization of the stapes by gentle traction by means of a hook, moving the stapes back and forth and up and down by traction on the stapedial muscle, and in some cases, removal of the incus and the malleus.

In 1890 Miot, in a report based on 126 cases with successful results in 74, concluded that in deafness without severe thickening of the tympanic membrane, in the absence of paracusis but with diminution of cranial perception and tinnitus, mobilization of the stapes gives good results even when the condition has persisted for several years.

In 1892 and 1894 Jack reported on 66 cases of stapedectomy, with "discouraging" results, concluding that the operation is not advisable in cases of sclerosis and that "most operations for mobilizing the stapes must be looked upon as largely experimental." In 1893, Politzer and, in 1894, Kessel reported that neither tenotomy, mobilization, or extraction of the stapes can be expected to improve hearing; Panse, Vulpius, Clark, Kaufman, Alt, and others, in the years from 1896 to 1898, reported indifferent results with their attempts to mobilize the stapes or with stapedectomy. A new facet was introduced in the year 1898, when Alderton of Brooklyn, having tried mobilization without success and later a stapedectomy in the same case, finally resorted to trephining the footplate. Labyrinthine fluid was seen to escape, according to his report, and there was no dizziness, but three weeks later the fenestra ovalis was hidden by cicatrical tissue. Tinnitus and hearing were the same as before the operation.

In 1897 Politzer summarized current thinking on stapes mobilization thus:

> The many attempts by Kessel, Boucheron and Miot to mobilize and remobilize the rigid stapes in the niche of the oval window, which sometimes had a temporary but short lived improvement of hearing, is completely abandoned.
>
> The same is true with the extraction of the stapes which was tried out by Kessel, Jack, Dench and others. Experiments on animals in this direction were made by Botey, Faraci, Politzer and others. Blake, Knapp, Cheatle, and Politzer do not advocate this operation.

By 1900 Siebenmann reported that all attempts at mobilization of the stapes in "sclerosis" are not only useless but often harmful, and that "avulsion of the stapes is no more successful." (The term "otosclerosis" was introduced about 1893, but Siebenmann did not use it.)

TWENTIETH CENTURY

No reports of further surgery for stapes fixation came from the great otologists of the early years of the twentieth century. Politzer, Neumann, Leidler, Ruttin, Blake, Jack, Dench, all remained silent. Almost no reports of further attempts to remobilize the ankylosed stapes were recorded until over 50 years later.

But this is not to suggest that progress was at a standstill in otology. Many important advances were made in the development of the radical mastoidectomy, physiology, and pathology and in the understanding of the physics of sound.

Attempted surgery for improvement of hearing being temporarily forgotten, mastoid surgery again became the primary concern of otologists. Emil Gruening was the first in the United States to publish a thoroughly detailed and precise analysis of mastoid surgery, basing his procedure on Schwartze's original technique as modified by Stacke, but adding further modifications of his own. Gruening seems to have been the first to advise that when the mastoid process harbors purulent inflammation extending beyond the antrum and involving the body of the bone, the tip should be removed as a routine matter. In 1905 Whiting advocated still another modification of the Schwartze-Gruening procedure, i.e., that all cellular structure from within the mastoid process, including the cells within the mastoid tip, must be exenterated during the performance of a simple mastoidectomy.

About this time too, early in the twentieth century, Edward B. Dench's precise indications for the radical mastoidectomy helped to establish a basic procedure in aural surgery. Emanuel Libman, world-famous American internist, in 1911 contributed to ear surgery by pointing out that in jugular sinus thrombosis, a positive blood culture is obtainable. The following year, Alfred Braun added to knowledge useful to ear surgeons by publishing a comprehensive treatise on the pathology, symptomatology and surgical treatment of sinus thrombosis.

In physiology and pathology the early 1900's saw the addition of these important observations: following Barany's notable publication in 1907 on the physiology of the vestibular labyrinth, Isador Friesner and Alfred Braun, in their book published in 1916, presented a basic and accurate picture of clinical labyrinthitis. Early in the 1920's, George E. Shambaugh, Sr., through his painstaking histologic studies gave new understanding to the anatomy and pathology of the inner ear. This highly significant work was augmented by Stacy Guild's investigations in correlation of the histologic findings with the clinical findings in inner ear diseases. Also in this period Sir Charles Ballance, forming a team with Arthur B. Duel and working in this country, conducted significant animal experiments in nerve grafting. Their researches led to presentation of the famous Ballance-Duel operation for facial nerve injury.

However, as important as the Ballance-Duel contribution was to otology, I must admit that a much better aid to otologic surgery and to humanity would have been a means for providing better training in temporal bone surgery, so that facial nerve injury would be less frequent. If, in spite of better knowledge, facial nerve injury accidentally occurred, the surgeon would know when, where and how it happened. With such understanding, an occasional injury to the facial nerve would be easily overcome. As a rule it could be corrected immediately, on the operating table, and permanent facial paralysis requiring the Ballance - Duel operation would be avoided.

In the same decade, Wells P. Eagleton's extensive investigations for unlocking the petrous pyramid of the temporal bone, in suspected presence of infection within the petrous apex, pointed the way to prevention of many cases of suppurative meningitis following temporal bone operations. In this same period, Samuel J. Kopetzky systematized the description of the symptoms of suppurative petrositis, and Ralph Almour described a technique for perforating and draining the infected petrous pyramid.

In 1927, publication of my paper, "Simple Subcortical Mastoidectomy," laid the foundation for the gradual development of the techniques for the endaural approach to all temporal bone surgery, and presented an available surgical procedure for drainage of the infected petrous pyramid.

This paper, the first, I believe, to describe the subcortical simple mastoidectomy technique, engendered immediate and widespread interest throughout the profession. In the years following the establishment of my own hospital in 1923, I was developing the endaural technique and had shown its advantages as the most direct approach to the temporal bone. It was also proving to be the most reliable approach to the mastoid antrum, without searching for it, and without danger of injury to any of the vital anatomy. This paper also served to dispel the erroneous view that had gained some currency in the literature that some patients have no mastoid antrum. In the many thousands of mastoid operations which I performed before that, and have done since the publication of that paper, I have never encountered a temporal bone in which the mastoid antrum was absent! This paper also recommended use of the drill to supplant the hammer and chisel.

It was to be expected that rebuttal arguments would be made. A number of articles appeared in the literature claiming that complete mastoid-cell exenteration was impossible with the endaural approach. In 1928, on invitation of Prof. Le Mee, I went to Paris to demonstrate this new procedure, and did so, at the Blumenthal Pavillon of the Hôpital des Infantes Malades. Next, at the invitation of Prof. Voss, in Frankfurt-am-Main, I again demonstrated the application of the endaural technique and then, at the invitation of Dr. Klaus, presented my paper on this technique at a meeting in Berlin. This was followed by a visit to Vienna, where, at the invitation of Neumann, Politzer's successor at the University of Vienna, I operated at the Wiener Allgemeines Krankenhaus. Before a group of distinguished European otologists I again performed a mastoid operation to demonstrate the reliability of the endaural approach and went on to show that all related complications could be handled successfully through the endaural route — sinus thrombosis, middle and posterior fossa abscess, and suppurative labyrinthitis. One of the patients entrusted to me by Neumann was a young child with a Bezold abscess. I demonstrated to the group that such infections could be treated successfully through the endaural route.

The following year, 1929, at the invitation of Prof. Le Maitre, I read a second paper on "Subcortical Mastoidectomy," and showed films, at the French Congress of Otolaryngology. Also at Le Maitre's invitation, I demonstrated my procedure at the Hôpital St. Louis. Then came an invitation from Bruhl, and I showed the procedure at the Maria Victoria Krankenhaus. Again at the Wiener Allgemeines Krankenhaus, at Neumann's invitation, I showed this operation in Vienna. At a meeting of the Wiener Gesellshaft der Arzte which followed, Neumann did not hesitate to report that he was con-

vinced of the efficacy of the endaural procedure for all mastoid surgery. "Everything can be seen," he said, "and where you see everything you can do everything." Thereafter, Beyer, of the Charitee Hospital in Berlin, reported his acceptance of the endaural approach and was the first to include a description of it in his textbook on mastoid diseases and their surgical treatment. Leidler, following the Vienna meeting, reported favorable results on a series of cases for which he used the endaural route.

My demonstrations in Europe proved the usefulness of the endaural approach for exenteration of infection within the petrous pyramid. A number of other papers appeared, among them those of Voss, in 1932, and Ramadier, in 1933. Each described a method for perforating and draining infection in the petrous apex. In 1936, publication of my paper, "Complete Apicectomy," brought into the literature complete directions for deliberate removal of all the cell structure with its diseased tissue from within the diseased apical portion of the petrous pyramid.

The next important milestone in the history of mastoid surgery was reached, I believe, with my paper, "Endaural, Antauricular Surgical Approach to the Temporal Bone," published in 1938.

These four papers (published in 1927, 1929, 1936 and 1938) furnish a reliable guide for the use of the endaural approach whenever surgical intervention in the temporal bone is necessary for any mastoid disease, including suppuration within the petrous pyramid. The basic surgical principles for the endaural approach permit:

1. Complete exenteration of the pathologic processes with a minimum of trauma, a minimum of healthy tissue sacrifice and with the least permanent postoperative deformity.

2. Step-by-step methodical exenteration of the cellular temporal bone structure, for deliberately planned, instead of accidentally encountered, visualization of all the vital temporal bone anatomy.

3. With proper lighting and magnification, direct and methodical exposure of all the vital anatomy, for added assurances against the possibility of overlooking any disease process within the temporal bone or of accidentally injuring any of the vital anatomy.

With these principles in mind, any well trained aural surgeon has a complete index of safe and comparatively simple mastoid techniques.

*Development of the Fenestration Operation*

The viable tympanomeatal pedicle flap employed for sealing a labyrinthine fistula in the performance of the endaural mastoidoatticotomy for chronic epitympanic suppuration, lead ultimately to the development of the practical one-stage fenestration operation for restoration of hearing in clinical otosclerosis.

Since all the important contributions to fenestration surgery were made in the last three decades, perhaps the historic background is known to most of you. However, a brief review of the chronology may add a point or two to the knowledge of this important work.

It is customary when describing the origin of operations for otosclerosis to start with the names of Kessel, Politzer, Passouw, and Panzer, concluding with a description of the work of Katz, who is given credit for the first full report of the pathology of stapes ankylosis, about 1890. There was obviously a tie between the recognized symptoms of the disease and the attempts to overcome them in the methods of treatment employed by these earlier aural surgeons. For ex-

ample, Politzer devised his method of inflation for the express purpose of attempting to mobilize the ossicular chain.

The first deliberate attempt to make a new vestibular window surgically apparently came from Jenkins, who in 1913 opened the semicircular canal in the belief that otosclerosis was due to changes in density of the labyrinthine fluid. Evidently he believed further that opening of the canal would alter the condition of the fluid. In his operation no fluid was seen to escape; the hearing improved only slightly at first, then retrogressed. Frazer, in Edinburgh, in 1919, is also reported to have experimented with opening the horizontal canal. Next, Barany operated on several patients for otosclerosis by opening the posterior bony canal. Although immediate improvement of hearing was noticed, it did not last. In 1923 Holmgren reported on his attempts at surgical treatment of otosclerosis, his innovation being the introduction of the binocular microscope. In three of four cases reported, hearing was improved.

The many failures and accidents that followed fenestration attempts in England apparently made it necessary to defer further trials of this surgery there. But the pioneers never entirely gave up. It had been proved beyond doubt that an opening in the semicircular canal would restore hearing if the deafness were caused by otosclerosis. Even a pinpoint opening would serve the purpose. The only problem which remained was how to prevent osteogenesis, with subsequent closure of the newly made opening.

To Gunnar Holmgren's persistence on the Continent, in the face of failure, may be attributed the eventual success of the fenestration operation and the fact that we have it today as a means for restoring hearing in clinical otosclerosis. When Maurice Sourdille set to work on the problems in the 1920's, it was through Holmgren's inspiration as a teacher, and the inspiration flowed both ways. Sourdille obviously inspired Holmgren to continue his efforts.

It was in 1924, after a visit to Holmgren, that Sourdille described his two-stage operation which he called "tympano-labyrinthopexy." In this procedure he performed a mastoidoatticotomy, retained the incus, removed the head of the malleus and skin-grafted the mastoid wound. After the mastoid wound had completely healed, he elevated the thin scar, and opened the horizontal canal. The scar, which became attached to the tympanic membrane, was replaced over the new window. An interval of six to eight months was necessary between the two stages of the operation. In a report at the New York Academy of Medicine in October 1937, he gave the results in 109 patients, reporting 40 per cent success, based on hearing for the whispered voice. He said that his main cause for failure was osteogenesis, with closure of the window, and in some cases, injury to the membranous canal.

In a letter dated April 12, 1938, read at a meeting of the American Otological Society, Holmgren said:

> It may be possible to obtain permanently open fistulas of the labyrinth, but until now this has been the case only occasionally, with Sourdille's material and with mine, and there is no known method for reaching this goal.

In 1938, with the publication of my paper, "Improvement of Hearing in Cases of Otosclerosis," there began a continuity of effort to perfect a technique for a one-stage fenestration operation that would provide for permanent improvement of hearing in clinical otosclerosis. This, I feel, has been achieved. With the Lempert fenestration operation, using what I term the novovalis dry technique, I believe we have the means of giving practical, serviceable

hearing in 90 per cent of the suitable cases of clinical otosclerosis. Suitability for the procedure can be determined preoperatively. I have now performed over 10,000 fenestration operations. Some of my patients have been watched for as long as 20 years and still have hearing that has been improved to the level where they can hear ordinary conversation without a hearing device; they have been restored to normal, happy lives, and are useful members of the community.

The foremost principles on which I based my surgical procedure for the fenestration operation are these:

Principle 1. Any technique employed to improve hearing in clinical otosclerosis must provide for the possibility of remobilizing the inner ear fluids by air-borne sound sufficiently to permit the restoration of practical, serviceable hearing, without the need of a hearing aid. The surgical research which I have carried out since the inception of the fenestration technique in 1938 has convinced me that to obtain such a degree of remobilization of the inner ear fluids a new covered fenestra must be created outside of the tympanic cavity, namely, in the external semicircular canal, to replace the covered intratympanic oval window functionally impeded by the otosclerotic growth. In 1950, Wever and Lawrence, reporting in the *Transactions of the American Otological Society* on the results of investigations of sound conduction in animals, confirmed the correctness of my theory that improvement of hearing following the fenestration operation depends upon the successful remobilization of the inner ear fluids. They said, "The fenestration operation, as we have seen, effects a remobilization of the cochlear fluid." As long as means for arresting the growth and spread of the otosclerotic tumor within the tympanic cavity remains unknown, the permanent maintenance of hearing improvement obtained by any surgery within the tympanic cavity will not be possible. To prevent the possibility that the continuously growing, and uncontrollable, otosclerotic tumor may become a threat to continuity of improved hearing, placement of the new fenestra outside of the tympanic cavity is an absolute "must."

Principle 2. In the use of any technique for the improvement of hearing by reconstruction of the air-conduction mechanism, the biologic, physiologic and physical factors involved in providing the continuous maintenance of such surgical reconstruction must be heeded.

Other basic features of the fenestration procedure are:

1. It includes means for predicting preoperatively the possibility for improving the hearing for air-borne sound to at least the 30 db level in the speech frequencies 512, 1024 and 2048 cps. The ability to hear at these levels is necessary for serviceable, unaided hearing. Normal hearing, following any surgical technique used for the improvement of hearing in otosclerosis, is rarely attained. Reports of such improvements will remain questionable until such time as audiometers are standardized by the Bureau of Standards.

2. The surgical technique employed is capable of improving hearing in any patient, no matter how low the preoperative audiometric reading indicates air-borne sound perception to be in these three frequencies, so long as the masked bone conduction hearing for pure tones in these frequencies has not fallen below the 20 db level.

3. The technique used incorporates a known, definitely prescribed, and time-proved means for deliberately conserving and permanently maintaining the hearing gain newly obtained by the oper-

ation. This is accomplished by using the invagination principle in covering the new fenestra, which prevents its osteogenetic closure and thus provides for its permanent functioning.

4. The procedure incorporates precautionary measures against any future labyrinthine infection secondary to middle ear infection which may occur during the life span of the patient. This is accomplished by placing the new fenestra outside the middle ear, covering and sealing it off without leaving any direct connection between it and the middle ear.

5. The operative technique makes use of the physiologic principle known to govern acoustic function of the inner ear following fenestration surgery. For this, also, placement of the new window outside the middle ear—covering and sealing it off without leaving any direct connection between the new vestibular window and the middle ear — accomplishes the purpose. This serves to vary the sound pressure acting on the round cochlear window and the newly created vestibular window. Thus, sound pressure reaching the intratympanic cochlear window is relatively less than the sound pressure acting on the newly created extratympanic vestibular window, and this provides the phase difference essential to mobilize the inner ear fluids by air-borne sound.

In connection with the surgical principles on which fenestration operation is based, some important contributions outside the field of surgical research should not be overlooked.

Among the investigations carried out by Ernest Glen Wever were those designed to show the results of such abnormal conditions as closure of either of the two windows. With the use of the precise methods he devised for determining the electric potentials of the ear and recording the actions of the ear in response to sound, he has been able to describe what happens when any one of the ossicles is disturbed and what occurs when the semicircular canal is opened in the performance of the fenestration operation. It was through these studies that he was able to show the correctness of my theory that remobilization of the inner ear fluids is essential for obtaining the improvement of hearing. In his recent book, "Physiological Acoustics," written in collaboration with Merle Lawrence, Wever confirmed the physiological principles underlying the fenestration operation as now employed by me and as generally adopted by otologists throughout the world.

Other significant studies in the theory of hearing which have practical application in ear surgery were made by Georg von Békésy. With the development of his instruments, which permit measurement of the vibrations of the eardrum and ossicles, and with further devices which follow the transmission of energy from the free sound field entering the ear, he was able to measure the reaction of sound on the innermost cells of the end organs. His invention of the "Békésy audiometer," which provides for automatic testing of hearing, removes from audiometry the probability of human error, and makes for more scientific testing.

The Lempert fenestra nov-ovalis operation was developed by observation and use of all applicable physiologic, biologic and physical principles.

Laboratory studies which I carried out with the assistance of Dorothy Wolff have made it possible to assemble the largest exhibit of histologic and microscopic sections on the temporal bone anywhere in the country, both in relation to otosclerosis and to Ménière's disease. My exhibit of sections of the ossicles proves the unmistakable presence of otosclerosis in the ossicles.

*Surgical Procedures for Ménière's Disease*

Contributions to temporal bone surgery as it relates to Ménière's disease begin with the observations reported by Hallpike and Cairns in 1938 that hydrops of the labyrinth is the cause of this disorder. For a time thereafter "labyrinthine hydrops" became a term of reference for Ménière's symptom complex, but whatever the terminology, surgical procedures designed to overcome the vertigo symptomatic of the disease were developed. An important surgical principle was set forth when Dandy described his operation in 1941. Dandy's method involved exposing the eighth nerve through an opening in the posterior fossa. Then the vestibular portion was separated; only *that* portion was severed in the hope of saving the hearing. To my mind Dandy's procedure would be a valuable adjunct to temporal bone surgery if there did not exist an intense popular antipathy to brain surgery. The true diagnosis of Ménière's disease rests on the fact that each attack of vertigo causes additional loss of cochlear nerve function. Today it is the rule not to operate in Ménière's disease until such time as the hearing loss in the involved ear is so severe that it is no longer useful.

Admittedly the other forms of surgery introduced for Ménière's disease are no cure for it, since they involve destruction of the residual hearing and the balance mechanism in the affected ear. However, contributions to methods for relief of the vertigo and imbalance were made by Cawthorne, through removal of the membranous labyrinth, and by Day, who performed a simple mastoidectomy, exposing the horizontal canal, and made an opening into the labyrinth through which a mild coagulating current was introduced.

My contribution to the surgical treatment of Ménière's disease consists of the operation for removal of the stapes and opening the round window membrane to permit the perilymph to escape gradually, so that there will be further and finally total degeneration of the membranous vestibular labyrinth. The technique used is the transtympanic approach which I first developed for use in middle ear surgery, when searching for and removing diseased tissue sometimes found in the hypotympanum in persistent cases of sero-otitis, and later used in the tympanosympathectomy procedure for relief of intractable tinnitus aurium. With this procedure it is possible to dislodge a part of the annulus fibrosus of the tympanic membrane from the sulcus tympanicus and to replace the membrane in its normal position without injury to it. This procedure has now been adopted as the first step in the stapes mobilization operation by those who are practicing this type of surgery today.

A theory of the cause of Ménière's disease has been advanced as a result of my studies of the membranous vestibular labyrinth removed *in vivo* during the performance of partial labyrinthectomy for the arrest of vertigo in this disease. I believe these to be the first such investigations of human labyrinths undertaken immediately following this operation, during the patient's lifetime. Histologic studies conducted by Dorothy Wolff on the series of over 30 such labyrinths removed, leads me to believe that the disease is of virus origin, related to herpes. We have shown the similarity between the lesions found in these diseases. We believe that Ménière's symptom complex is the result of epithelial vesiculation, that the vertiginous attacks occur when one or more vesicles rupture, with release of fluid toxic to the labyrinthine contents. Further research in this field is being carried on at the

Lempert Institute of Otology. The Lempert Institute has a grant from the United States Public Health Service for assistance in this research.

*Antibiotic Therapy*

The introduction of the chemotherapeutic drugs and the antibiotics had advantages and disadvantages.

Antibiotic therapy was of enormous value in the treatment of ear diseases, even life-saving in cases of meningitis and intracranial complications of otitic origin. The safety provided by antibiotics made it possible to develop some of the current surgical procedures, for example, the one-stage fenestration operation.

One great disadvantage, however, seemed to be that of distorting the surgeon's judgment, especially with respect to otitis media. For a time it seemed that the usage of antibiotics had led to a permanent and unjustified abandonment of an important surgical principle — the provision for drainage of infection wherever found in the body. Complete reliance on antibiotics led to much difficulty in diagnosing and treating middle ear infections and even created another surgical problem—that of treating middle ear infections that had been badly mismanaged because of unwise reliance on the antibiotics, particularly penicillin. Physicians forgot that when suppuration began, antibiotics were of no avail, since the disease is localized in its bony cage.

Another facet of this problem was that an apparently arrested otitis media recurred again and again, and became transformed into a chronic condition which injured hearing. The use of antibiotics masked the underlying condition by eliminating pain and fever, so that proper diagnosis was often missed.

Otologists, general practitioners and pediatricians are coming back to the understanding that myringotomy remains a useful and necessary operation, in conjunction with antibiotic therapy.

The oversimplification of the problem of treatment of chronic ear infections with antibiotics had another disadvantage — its effect on interest in otology as an important field of specialization. For a time, in the 1940's, it became popular in medical circles to speak of otology as a dead or dying specialty. Fewer men were undertaking training in otology, hospitals had difficulty in obtaining the requisite number of residents in this specialty, and fewer well-trained ear surgeons practiced otology.

Now, evidently the perspective is better, and a new crop of men has been attracted to otology, perhaps by the popularization of the revived stapes mobilization technique. Whatever the reason, it is hoped that the talented among them will stay in the field, will explore those areas in which so much fundamental knowledge and endeavor remains to be acquired, and in which so much basic theoretic and clinical research remains to be done. If they will obtain the intensive training and experience that is required of competent temporal bone surgeons, they will find their work highly rewarding and will make real contributions to the cause of good medical practice and to the community.

*Tympanoplasty and Related Procedures*

In the current interest in tympanoplasty we again see a reversion to an earlier period in the evolutionary development of temporal bone surgery.

Politzer reported on early attempts by several nineteenth century otologists to close tympanic membrane perforations with skin grafts. Evidently the trials were not successful and, like early stapes

mobilization attempts, were soon abandoned. Kessel in Europe, and Roosa in the United States are among those whom Politzer mentions in his "History of Otology" as having tried plastic repair of the drum membrane without success.

Then, as now, the efforts at plastic closure of perforations in the eardrum were directed toward removal of diseased tissue and reconstruction of what in effect will be a new middle ear and which will constitute a closed, air-filled space lined with mucosa and which will communicate with the nasopharynx, that is, with an open eustachian tube and sealed-off round window membrane.

In Europe, based upon the principle of surgical remobilization of the inner ear fluids, Wullstein and Zollner have contributed greatly toward the improvement of tympanoplasty technique. In the United States a number of temporal bone surgeons are making attempts to employ this operation and to devise their own modifications of it.

Another more logical surgical procedure for the improvement of hearing in deafness secondary to chronic middle ear suppuration has been introduced by J. H. Thomas Rambo. It is a combination of fenestration and tympanoplasty and is termed "musculoplasty." The viable temporal muscle pedicle flap is used to cover the new fenestra and to create a tympanic air space. The continuous maintenance of the initial improvements in hearing obtained with this surgery will ultimately depend upon the amount of consideration given to the biologic, physiologic and physical factors involved.

The basic principle of today's surgery —under the name of tympanoplasty—is still the remobilization of the inner ear fluids. Only time will tell whether the long-term results of these renewed efforts will be any better.

*Miot's Stapes Mobilization Technique*

The recent re-introduction of Miot's stapes mobilization technique raises some interesting historic questions. It is approximately sixty years since he reported on 126 cases, with indicated success in 74. Significantly, the literature of the day offers little evidence that the technique was successfully used by any other of the great temporal bone surgeons of that era. In fact, the literature discloses fully that stapes mobilization attempts were so rarely successful that the procedure was immediately made more drastic. Stapedectomy as a trial and error procedure in stapes ankyloses came quickly on the heels of the attempts to mobilize the rigid stapes.

It does not seem reasonable to assume that the great surgeons of that period, who were constantly seeking a method of surgical intervention for the improvement of hearing in stapes fixation, would have abandoned the use of a technique which initially seemed to offer so much. Fenestration of the semicircular canal had not yet been thought of and, indeed, stapes mobilization was the only method which had been suggested by anyone. Given a group of outstanding ear surgeons and any technique for possible improvement of hearing, is it not logical to assume that if the procedure offered even limited success, it would have been tried? Yet there is no mention in the literature of the day that Politzer, or Neumann, or Leidler, or any of the other great European otologists tried it. Blake, a Politzer pupil, made some few attempts to obtain hearing improvement with stapes mobilization, but he, too, quickly went on to the more drastic and inherently more uncertain procedure of removing the stapes. Finally the very dangerous operation of making a hole in the footplate was tried.

As of this writing, no one has attempted to explain this historic anomaly. Although there are many accounts of the clinical success of the procedure since its re-introduction five years ago, there is yet a complete dearth of convincing evidence which would justify its use on fundamental surgical principles.

Surgical intervention in deafness of otosclerotic origin by stapes mobilization, or any variation of the technique, should rest on the following two principles: (1) the ability, preoperatively, to diagnose the possibility of successfully mobilizing the stapedio-vestibular joint without disruption of the ossicular chain; and (2) the possibility of deliberately providing for the permanent maintenance of the mobilized state of the stapes. Until evidence is forthcoming that these basic conditions are satisfied, the Miot technique will not have earned its place as an acceptable procedure in the surgery for otosclerotic deafness.

Mobilization of the stapes, as practiced today, is a destructive, nonsurgical orthopedic procedure, with complete disregard for the biologic and physiologic factors upon which maintenance of the improvement will depend. Because the mobilization is carried out in the immediate region of an actively growing tumor, the fixation is almost certain to recur.

A basic oversimplification of the problem is the assurance that if mobilization fails, fenestration may then be undertaken. Although assurance is, in many instances, doubtful of accomplishment, it may well account for the recurrent acceptance of the mobilization procedure. Acceptance by the patient of such assurance, however, is a great tribute to the Lempert nov-ovalis operation.

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# SURGICAL TREATMENT OF CARCINOMA OF THE EPIGLOTTIS BY LATERAL PHARYNGOTOMY

MAX L. SOM
NEW YORK, NEW YORK

LATERAL pharyngotomy, as a definitive surgical approach for the extirpation of carcinoma of the epiglottis, was originally described by Trotter[17,18] in 1913. Colledge,[3] Orton[13] and more recently Alonso[1,2] employed this procedure; but popular acceptance was never achieved because of the need for the creation of a temporary pharyngostome with the attendant discomforts, such as drooling of saliva, dysphagia and aspiration. In addition, secondary plastic closure of the pharyngostome with skin flaps was routinely necessary and often proved protracted and troublesome.

Ogura[11,12] has demonstrated his technique for supraglottic subtotal laryngectomy and radical neck dissection for carcinoma of the epiglottis with primary closure, using a muscle flap and skin graft. In this operation, both internal laryngeal nerves are sacrificed and a period of training for re-education of deglutition is required.

The following proposed procedure permits the removal of carcinoma of the epiglottis "en masse" with all the structures of the pre-epiglottic space (fig. 1). It is designed for a selected group of patients who will be described in detail later. Primary closure is attained without resort to skin grafts. "En bloc" radical neck dissection, in continuity with the hyoid bone, can be simultaneously performed if deemed necessary. By the proposed supraglottic dissection, the vocal cords are spared and laryngeal function is preserved. However, the larynx must not be conserved at the risk of too limited an excision with the resultant exposure of the patient to local recurrence.

In the clinical experiences of Alonso[1,2] and Leroux-Robert,[8] carcinoma of the epiglottis remains confined to the supraglottic region until late in the disease. Involvement of the glottis occurs only in extensive lesions of the sort that would be considered Stage 3 by Lederman.[7]

Frazer[4] has shown that the embryological development of the supraglottic structures occurs quite independently from the subglottic portions of the larynx. If a line is drawn backward along the true vocal cord to the vocal process of the arytenoid and then continued upward to the prominence of its apex, that part which lies below and behind is derived from the pulmonary anlage. The portion above such a glottic line, including the epiglottis, folds and false cords, develops from the primitive pharynx and in reality is included as part of the pharynx.

Anatomically, the tendency for limitation of growth of carcinoma of the epiglottis to the supraglottic area is understandable. Pressman's recent excellent dissertation[14] helps elucidate some of the reasons why epiglottic lesions may remain locally confined for some time. With controlled pressure, a dye, injected into the aryepiglottic fold, spreads downward to the level of the false cord, but not below it. Pressman thus demonstrated an anatomic compartment that comprises the supraglottic area above the

From the Head and Neck Division of the Surgical Service, Montefiore Hospital, New York.

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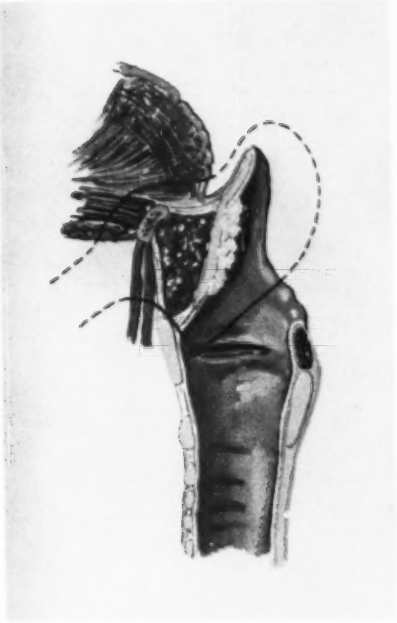

FIG. 1—Line of excision permits extirpation of epiglottis with tumor in continuity with hyoid bone and pre-epiglottic space.

level of the false cord. These findings were confirmed *in vivo* studies. Furthermore, the lymphatic drainage from the supraglottic structures is distinct and separate from that of the glottis and subglottic areas. Rouvière[16] has shown that the lymphatic channels draining the area above the vocal cords pass out through the aryepiglottic and pharyngoepiglottic folds in company with the superior laryngeal vessels to the deep jugular chain. The lymphatics from the subglottic region leave the larynx at the lower border of the thyroid cartilage passing through the cricothyroid membrane anteriorly, and with the inferior laryngeal vessels and recurrent nerve posteriorly.

While there exist such anatomic barriers to the spread of carcinoma of the epiglottis to the glottis and subglottic areas, access to the pre-epiglottic space is readily available. The pre-epiglottic space is bounded anteriorly by the upper border of the thyroid cartilage and the thyrohyoid membrane. Cephalad, it is limited by the hyoid bone and the suprahyoid tongue musculature and vallecula. Posteriorly, its boundary is the epiglottic cartilage which is wide above and tapers to a point inferiorly. The petiolus is attached in the midline to the inner aspect of the thyroid cartilage, a short distance below its anterior upper border by the thyroepiglottic ligament. This space is mainly occupied by areolar fat tissue and cervical fascia rich in lymphatic channels. A tumor of the laryngeal surface of the epiglottis has access to the pre-epiglottic space by the defect existing between the alae of the thyroid and the tapering petiolus. Clinically, early invasion of this space occurs in carcinoma of the epiglottis. Cervical node metastases in the presence of infiltration of the pre-epiglottic space is very common, yet local extension of the tumor inferiorly is rare.

From our knowledge of the anatomic compartmentation of the supraglottic structures, their independent lymphatic drainage and the acknowledged clinical behavior of carcinoma, it would seem possible to excise completely certain, selected carcinoma of the epiglottis without sacrificing the entire larynx. In fact, this has been done with a considerable measure of success by Alonso[1,2] and Ogura.[11,12] The clue to success must depend largely on the selection of individual cases and the adherence to rigid criteria for epiglottectomy via lateral pharyngotomy.

## INDICATIONS FOR EPIGLOTTECTOMY BY MEANS OF LATERAL PHARYNGOTOMY

In a series of 344 cases of surgically treated carcinoma of the larynx the epi-

glottis was regarded as being the primary site of the neoplasm in 33 instances. The latter cases were subdivided into three groups.

1. Lesions were confined to the suprahyoid portion of the epiglottis (no palpable nodes) in 10 cases.

2. Lesions of the laryngeal cartilaginous surface of the epiglottis did not involve the aryepiglottic folds and did not extend distally beyond 1.5 cm. above the anterior commissure (no palpable nodes) in 6 cases.

3. Advanced lesions of the epiglottis either infiltrated the aryepiglottic folds, ventricular bands and glottis or extended into the vallecula, with or without palpable nodes, in 17 cases.

For the advanced lesions, a combined total laryngectomy and simultaneous neck dissection was routinely performed, even in the absence of palpable lymph nodes.

This presentation concerns the 16 cases of groups 1 and 2, namely, all the carcinomas of the epiglottis not involving the aryepiglottic folds, not extending distally more than 1.5 cm. above the anterior commissure and not having palpable lymph nodes (fig. 2). The operation to be presented was performed 10 times for limited suprahyoid lesions. An elective neck dissection in continuity was done in 6 additional instances when the lesion involved the base or infrahyoid portion of the epiglottis.

Lesions deemed suitable for lateral pharyngotomy were selected after mirror examination, direct laryngoscopy, biopsy and tomography. Occasionally, the inferior extent of the carcinoma can be demonstrated by lateral tomograms. Extension of the neoplasm into the pyriform fossa or vallecula may become more apparent by radiography (fig. 3).

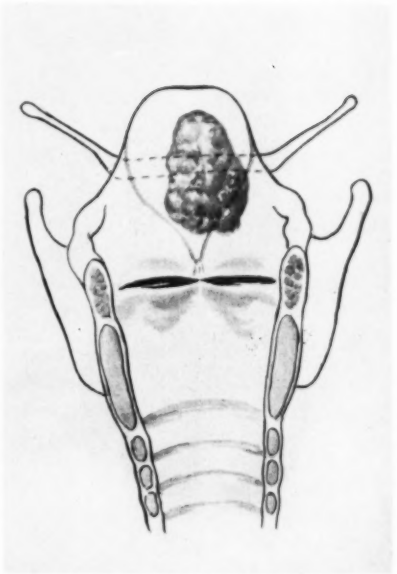

FIG. 2—Lesion suitable for epiglottectomy by means of lateral pharyngotomy with radical neck dissection. Infrahyoid extension on cartilaginous surface must leave safe margin above anterior commissure. Aryepiglottic folds and false cords are not involved.

FIG. 3—Oblique view outlining carcinoma of the epiglottis. The lesion involves the aryepiglottic fold thus rendering the tumor unsuitable for epiglottectomy.

Laryngeal nebulization of Dionosil or Ethiodol may coat the mucosa of the epiglottis and yield a striking contrast film. The smooth contour of the mucosa may be seen to be interrupted by the lesion whose edges are delineated by collection of the dye. Submucosal extension of the carcinoma distally, beyond that visible by direct laryngoscopy, may possibly be directed by this view (fig. 4).

FIG. 4—Lateral view of larynx after nebulization of Ethiodol. Submucosal extension of the carcinoma distally to the anterior commissure. Limited excision not feasible.

Final decision to perform a partial laryngectomy or epiglottectomy, as against total laryngectomy, was made only after exposure of the lesion by pharyngotomy. Only in this way can the extent of the neoplasm be definitely ascertained and then adequate surgical treatment instituted. Previous consent for total laryngectomy was always obtained before beginning the operation. Extension of the carcinoma into the aryepiglottic fold and false cords or involvement of the anterior commissure makes total laryngectomy mandatory.

An elective neck dissection on the side of maximum involvement was performed when the lesion was infrahyoid. To date, no case of palpable metastatic nodes was included in this small series, although two instances of nonpalpable positive nodes were subsequently proved microscopically. The reason that the larynx was not spared in cases of palpable nodes is that the rate of cure of carcinoma of the epiglottis with such palpable metastases is 28 per cent, even after total laryngectomy and radical neck dissection. Experience may prove that the failures are not associated with preservation of the larynx but are rather the result of metastatic disease.

## OPERATIVE TECHNIQUE

### *Limited Lesions of the Suprahyoid Portion of the Epiglottis*

After local infiltration of Zylocaine, a tracheotomy is done through a transverse incision and thereafter general anesthesia is maintained with Pentothal Sodium. A curvilinear, cervical incision (fig. 5) is made corresponding to the upper arm of the routine radical neck incision. A second incision is made perpendicular to the initial one at about its midportion. If necessary, this second longitudinal incision can be converted into the vertical portion of the classic horizontal-H incision employed for radical neck dissection.

The sternohyoid and omohyoid muscles (fig. 6) are severed below their attachments to the hyoid bone and the thyrohyoid muscle is excised, exposing the thyrohyoid membrane and the upper two thirds of the lamina of the thyroid cartilage. The superior laryngeal vessels

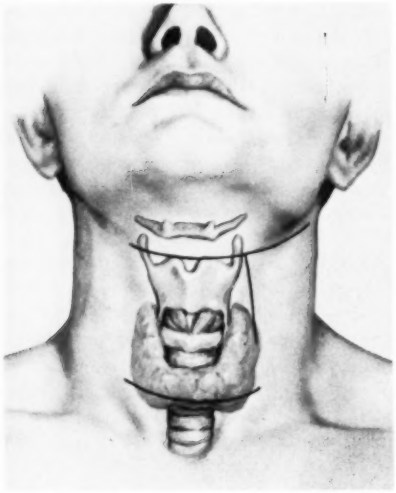

FIG. 5—With local anesthesia, a tracheotomy is done through a transverse incision. A curvilinear cervical incision is then made corresponding to the upper arm of the routine radical neck incision. The lower skin flap is cut perpendicularly for better exposure.

FIG. 7—The hyoid bone is grasped and removed after both the suprahyoid and infrahyoid muscular insertions are severed.

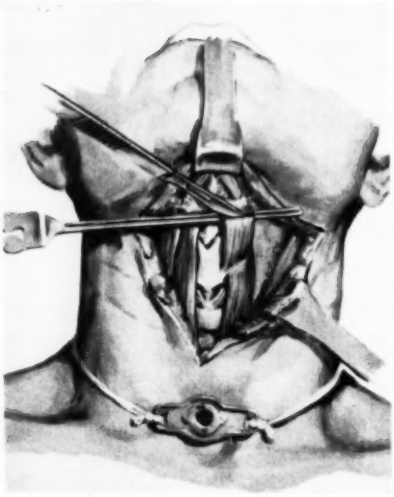

FIG. 6—The sternohyoid and omohyoid muscles are transected below their attachments to the hyoid bone and the thyrohyoid muscle is excised.

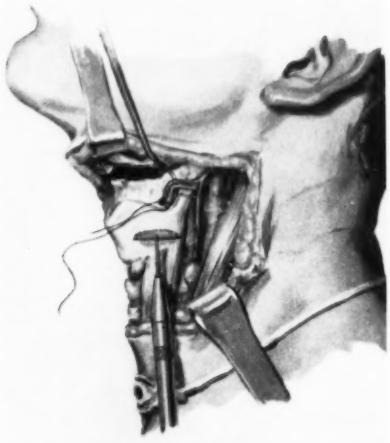

FIG. 8—The superior laryngeal vessels and the internal laryngeal nerve are isolated and ligated at the upper border of the thyroid cartilage. After separation of the inferior constrictor muscle, the upper half of the thyroid lamina is sawed through and freed from the soft structures of the larynx.

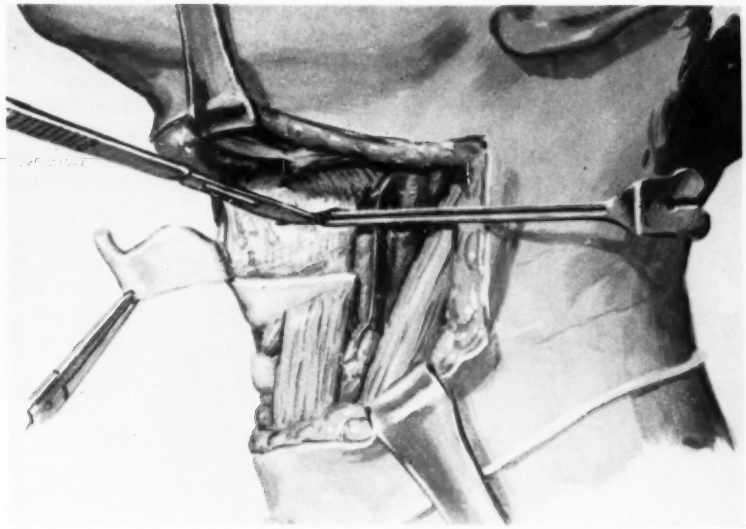

FIG. 9—The hypopharynx is entered posterolaterally after incision of the thyrohyoid membrane, the constrictor musculature and the mucosa of the pharynx.

and the internal laryngeal nerve are isolated laterally and ligated at the upper border of the thyroid cartilage, just anterior to the projection of its upper cornua.

The hyoid bone is removed by severing its muscular insertions above and below (fig. 7). Such excision of the hyoid bone allows for better exposure and facilitates handling of the tissues, yet in no way limits the extent or magnitude of the excision. To secure further exposure, the upper half of the thyroid ala is removed by cutting through the cartilage with a Stryker saw and then dissecting it free from the soft tissues of the larynx (fig. 8). Posteriorly, this separation from the inferior constrictor muscle and the mucosa of the pyriform fossa is easy, but anteriorly, sharp dissection is necessary to avoid piercing the vocal cords. The free rim of the epiglottis can now be palpated

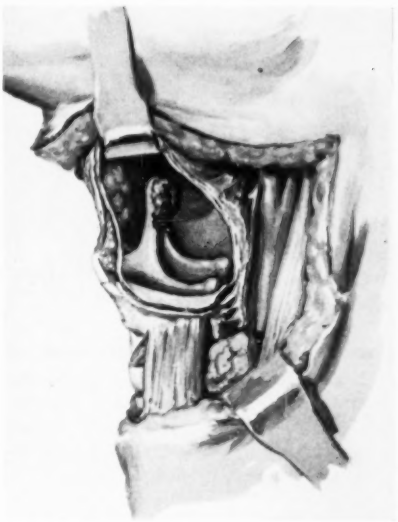

FIG. 10—The pharyngeal mucosa and the base of the tongue are retracted cephalad. The mucous membrane and the lateral wall of the pyriform fossa are folded over the remaining lower portion of the thyroid ala. An excellent exposure of the supraglottic structures, as well as the arytenoid and pyriform fossa, is thus obtained.

through the thyrohyoid membrane for better orientation. The hypopharynx is entered posteriorly, above the aryepiglottic fold, after first incising the pharyngeal constrictor muscle and then the mucous membrane (fig. 9). The pharyngeal mucosa is retracted upwards, thereby permitting an excellent exposure of the supraglottic structures, as well as the arytenoid and pyriform fossa (fig. 10). Traction on a silk suture, passed through the lingual surface of the epiglottis, will allow thorough inspection of the limits of the lesion.

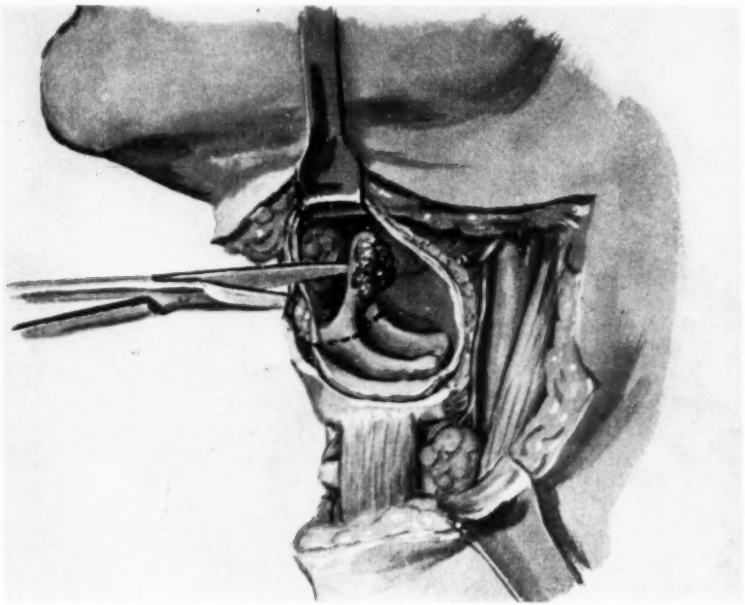

FIG. 11—Below, the line of excision begins with the ipsolateral aryepiglottic fold and continues along the upper border of the transected thyroid cartilage. Above, the incision separates the epiglottis and contents of the pre-epiglottic space from the musculature and mucosa of the tongue.

Extirpation of the tumor is begun anterior to the arytenoid by incising the ipsolateral aryepiglottic fold. The mucosa of the upper, mesial wall of the pyriform fossa and the mucosa of the false cord will thus be transected. The excision is continued along the upper border of the transected thyroid cartilage laterally and the undersurface of the ventricular band mesially (fig. 11) up to the anterior commissure. The dissection is carried across the midline to the opposite side. The true cord remains below, having been separated transversely from the false cord, the anterior portion of the ventricle and epiglottis above.

A finger is now inserted into the vallecula and the epiglottis and contents of the pre-epiglottic space are severed from the musculature and the mucosa of the tongue. The epiglottis, including the tumor mass and pre-epiglottic tissues, is still attached to the contralateral side of the larynx. Upward traction is now exerted on the epiglottis and the surgical specimen is freed by excision of the lat-

eral wall of the larynx along the anterior portion of the opposite aryepiglottic fold and ventricular band toward the anterior commissure of the true cords. It is apparent that less of the aryepiglottic fold and false cord are sacrificed on the uninvolved side (fig. 12). This is essential in order to avoid injury to the opposite, remaining internal laryngeal nerve.

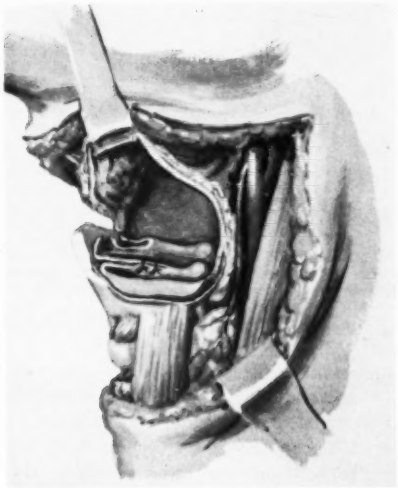

FIG. 12—The excision is continued across the anterior commissure and along the upper border of the contralateral thyroid cartilage so that less of the opposite aryepiglottic fold is sacrificed. The mucosa of the false cord and the mucous membrane forming the mesial wall of the pyriform fossa are approximated by sutures.

After piercing the thyroid membrane, this (sensory) laryngeal nerve splits into many diverging branches. Intralaryngeally, these are distributed (Hollinshead[5]) to the posterior aspect of the base of the tongue, the laryngeal surface of the epiglottis and the mucosa of the larynx itself. Except for the few anterior branches going to the epiglottis, the main divisions of the internal laryngeal nerve are located below the upper border of the thyroid cartilage (fig. 13). Thus

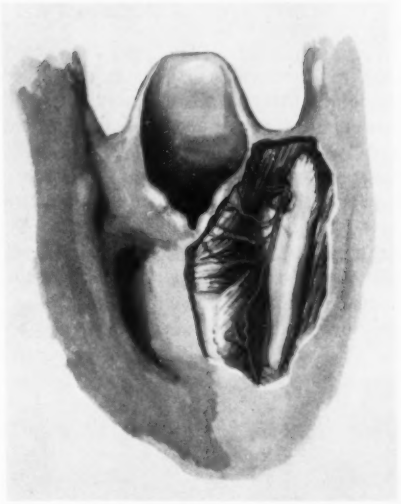

FIG. 13—The internal laryngeal nerve pierces the thyrohyoid membrane and then subdivides. Except for a few branches which proceed to the epiglottis and vallecula, the main divisions to the larynx are located below the upper border of the thyroid cartilage anteromedially. Laryngeal sensation may be preserved if final excision hugs the upper rim of thyroid cartilage.

the major sensory nerve supply to the larynx can be spared if the trunk of the internal laryngeal nerve be preserved, as it penetrates the thyrohyoid membrane and the main divisions are avoided by limiting the excision anteriorly, above the level of the thyroid cartilage. Accordingly, care is exercised in the final separation of the surgical specimen to avoid injury to the main divisions of the internal laryngeal nerve by hugging the upper margin of the intact thyroid cartilage.

In this series both internal laryngeal nerves have not knowingly been sacrificed, although Ogura[11,12] has done so and still found his patients able to resume normal swallowing after an interval of time. It is probable that more extensive bilateral epiglottic lesions might be suitable for subtotal suprahyoid laryngectomy if no attempt whatever is made to preserve the internal laryngeal

nerves in the process of obtaining a wide excision.

After removal of the specimen, the suspended larynx is reattached to the musculature and mucosa of the tongue and constrictor pharynx. The head is sharply flexed facilitating this approximation. The continuity of pyriform fossa on the ipsolateral side is secured by suturing the mucosa of its mesial wall with the remaining portion of the ipsolateral false cord. This step is not essential on the contralateral side.

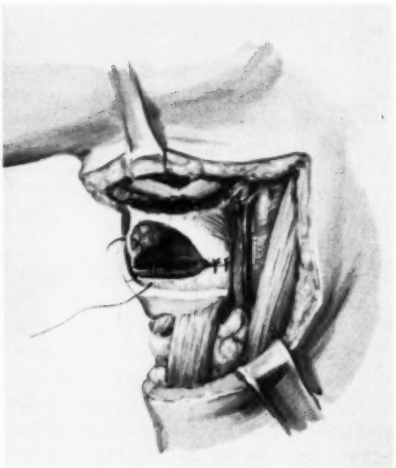

FIG. 14—The suspended larynx is reattached to the musculature and mucosa of the base of the tongue. Posterolaterally, the mucosa of the laryngopharynx and pharynx are easily reunited by sutures. Anteriorly, the approximation is more difficult and good apposition is not always obtainable.

Closure is begun laterally by uniting the retracted mucosa of the pharynx and laryngopharynx, after passage of a nasogastric feeding tube (fig. 14). Anteriorly, this approximation becomes more difficult but the mucosa from the vallecula can be sutured to the mucous membrane of the lateral wall of the pyriform fossa and whatever remains of laryngeal

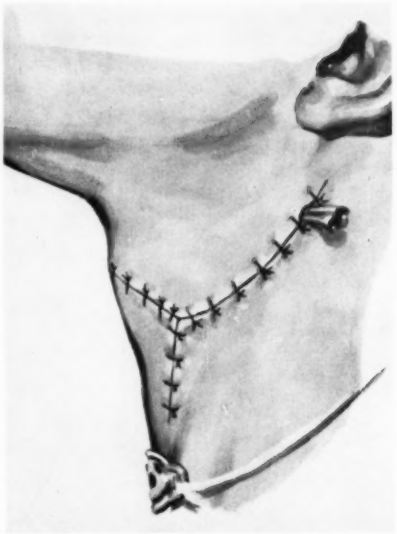

FIG. 15—A Penrose drain is inserted and the wound is closed by primary union without resort to pharyngostomy. A temporary tracheotomy is required for 10 to 14 days.

mucosa anteriorly. Good mucosal apposition is not always obtainable, especially in short-necked patients, but healing has never been delayed. A second layer of interrupted sutures, approximating the musculature of the tongue and pharynx, secures the suture lines. A Penrose drain is inserted and the wound closed by interrupted chromic subcutaneous sutures and silk for the skin (fig. 15). A tracheostomy tube is left in place and antibiotic therapy is administered. A plaster cast is now applied so as to maintain flexion of the head during the first postoperative week (fig. 16).

### *Carcinoma of the Infrahyoid Surface of the Epiglottis*

These selected cases neither involve the aryepiglottic folds nor extend distally beyond 1.5 cm. above the anterior commissure and have no palpable metastatic nodes.

FIG. 16—Flexion of the head is maintained during the first postoperative week by plaster cast which is applied immediately after the operation.

A routine radical neck dissection is performed as described by Huffman and Lierle,[6] using a classical horizontal-H incision (fig. 17) employed by Martin and his colleagues.[9] The skin flaps are elevated deep to the platysma and the inframandibular branch of the facial nerve is preserved. The sternal and clavicular attachments of the sternomastoid muscle are severed and the dissection continues from below up. The entire lymph-bearing structures of the posterior cervical triangle are removed and only the carotid artery, phrenic and vagus nerves remain (fig. 18). The accessory nerve has occasionally been presented in an elective neck dissection when the primary lesion of the epiglottis has been exophytic rather than ulcerative. The insertion of the sternomastoid muscle into the mastoid tip is severed as is the lower portion of the parotid gland. A high ligation of the internal jugular vein is obtained by retraction of the posterior belly of the digastric muscle (fig. 19). The dissection is now continued anteriorly, removing the contents of the submaxillary triangle but maintaining continuity with the hyoid bone and the thyrohyoid membrane. The fascia and glands from the submental triangle are dissected inferiorly, toward the hyoid bone (fig. 20).

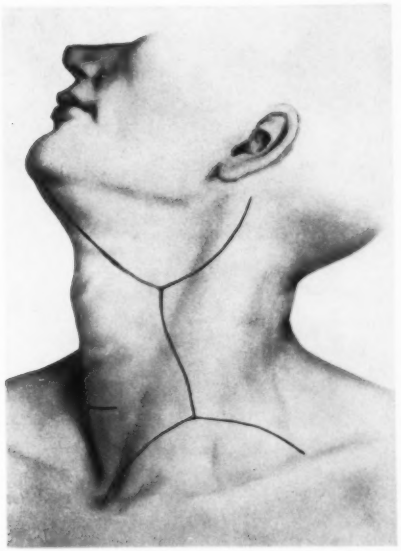

FIG. 17—A routine radical neck dissection is performed using the classical horizontal-H incision.

The surgical specimen, removed by the radical neck dissection, separated from the carotid artery, but still attached to the hyoid bone, is bound together with a heavy silk ligature and displaced laterally. The infrahyoid muscles are transected above the oblique line of the thyroid cartilage and retracted, care being taken not to disturb the attachment of the neck dissection specimen to the hyoid region (fig. 21). The posterior margin of the thyroid cartilage is freed by separation of the inferior constrictor muscle and mucosa of the pyriform fossa. The cartilage is then divided horizontally with a Stryker saw and the upper half is removed. The suprahyoid muscles are now severed from the body, the lesser and greater cornua of the hy-

FIG. 18.—The skin flaps have been elevated and the inframandibular branch of the facial nerve is preserved. The sternal and clavicular heads of the sternomastoid have been severed and the dissection continues from below up. The internal jugular vein is ligated and the entire lymph-bearing structures of the posterior cervical triangle are dissected free and elevated. The carotid artery, the vagus and phrenic nerves and the brachial plexus remain.

FIG. 19—The insertion of the sternomastoid muscle into the mastoid tip is severed and the lower portion of the parotid gland is transected. A high ligation of the internal jugular vein is obtained by retraction of the posterior belly of the digastric muscle. The hypoglossal nerve is not disturbed.

FIG. 20—The dissection is continued anteriorly and the contents of the submental and submaxillary triangle are dissected free and reflected downward toward the main mass of the neck dissection. Continuity of the surgical specimen with the larynx is maintained by muscular and fascial attachments to the hyoid bone and thyrohyoid membrane.

FIG. 21—The infrahyoid muscles are transected and the thyroid cartilage is divided horizontally with a Stryker saw. The suprahyoid muscles are severed. The pulley of the stylohyoid and digastric muscles are detached and the stumps of the mylohyoid, geniohyoid and hyoglossus remain attached to the hyoid bone.

FIG. 22—The hypopharynx is entered at the posterior tip of the greater cornua of the hyoid bone and the operation proceeds in the same fashion as previously illustrated. The surgical specimen included the neck dissection in continuity with the hyoid bone, the pre-epiglottic space and the epiglottis with the tumor en masse.

oid bone. The stumps of the mylohyoid and geniohyoid muscles remain attached to the body; and the hyoglossus to the greater cornua. The pulley of the styohyoid and the digastric muscles are detached and retracted upward. The hypopharynx is entered at the posterior tip of the greater cornua of the hyoid and the operation proceeds in the same fashion as previously described (fig. 22).

The main difference in the surgical technique, with the combined operation, is that the hyoid bone is not disturbed until its removal, in continuity with the epiglottis, pre-epiglottic space and structures of the radical neck dissection. The excision is actually not significantly wider, although the stumps of both the suprahyoid and infrahyoid muscles are included in the "en bloc" dissection. If the hyoid bone, thyrohyoid membrane or prelaryngeal muscles are involved, the above procedure is inadequate and a total laryngectomy and neck dissection are indicated.

## COMPLICATIONS

Prompt healing of the wound was obtained in every case and no pharyngeal leak developed. In most cases the patient was decannulated by the tenth postoperative day and in no instance was the tracheostomy necessary after three weeks.

Alimentation was maintained for the first 10 days by nasogastric feeding. After this interval, the patient was permitted to take food by mouth. At the beginning, swallowing is a conscious effort and liquids may spill over into the larynx and provoke a spasmodic cough. Semisolids are better tolerated, especially if the patient is encouraged to lean forward and swallow with the head inclined to the less involved side. With one exception, every patient has relearned swallowing and has retained the laryngeal reflex.

In one patient, aged 70, an epiglottectomy by means of lateral pharyngotomy was performed for a carcinoma of the suprahyoid surface of the epiglottis. A simultaneous radical neck dissection was not done and the opposite internal laryngeal nerve was not knowingly traumatized. Nevertheless, he never re-educated himself in the manner of swallowing without his epiglottis and with but one functioning internal laryngeal nerve. Over a period of six months, he had four attacks of aspiration pneumonia, until finally a total laryngectomy was performed in order to avoid further lung infections from repeated aspirations. His tracheotomy tube, which had been removed after the first two weeks, was reinserted but its presence did not prevent the subsequent pneumonias. The excised larynx showed no gross or microscopic evidence of residual tumor.

Patients about 70 years or older may never overcome their initial difficulty in deglutition following epiglottectomy. Similar experiences with aged patients who have had a hemilaryngectomy and removal of one arytenoid seem to indicate that such partial or subtotal laryngectomies may not be advisable for patients in the old age group. Younger patients, however, soon re-educate themselves in manner of swallowing without the epiglottis, internal laryngeal nerve or arytenoid. Three patients developed a fixation of the ipsolateral vocal cord, postoperatively, which has persisted.

## RESULTS

Of 344 patients with carcinoma of the larynx, 33 had the primary lesion in the epiglottis. In 17, the lesion was extensive and was treated by total laryngectomy with radical neck dissection with a 28 per cent survival rate. Sixteen patients were operated upon by epiglot-

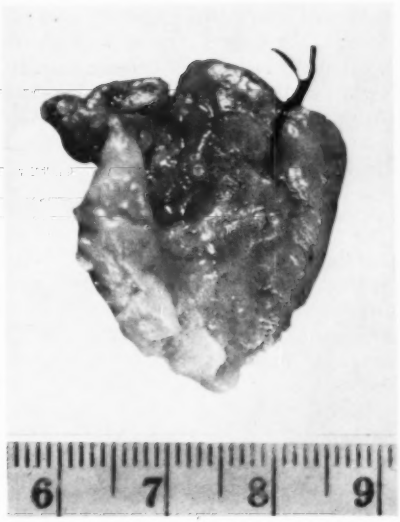


FIG. 23—Surgical specimen showing carcinoma of suprahyoid portion of the epiglottis. Lesion removed by epiglottectomy by means of lateral pharyngotomy. The patient was alive and well eight years postoperatively.

FIG. 24—Carcinoma of epiglottis removed by epiglottectomy by means of lateral pharyngotomy. The patient was alive and well four years postoperatively.

tectomy by means of lateral pharyngotomy and 6 of these had a simultaneous radical neck dissection in continuity. Of these 16 patients, 13 (81 per cent) are alive and well two to eight years after operation, 6 being free of disease over five years (figs. 23-31).

FIG. 25—Sagittal section of carcinoma of epiglottis demonstrating uninvolved distal portion of epiglottic cartilage and peteolus. Lesion was excised by lateral pharyngotomy and radical neck dissection. The patient was alive and well three years postoperatively.

ANALYSIS OF FAILURES

1. One patient previously had been treated unsuccessfully with radiotherapy for a carcinoma of the midportion of the epiglottis and had residual disease. An epiglottectomy by means of lateral pharyngotomy was performed but the wound never healed. On the twelfth postoperative day, hemorrhage from erosion and slough of the external carotid artery proved fatal.

2. Another patient was also previously treated by radiotherapy with persistence of cancer in the proximal half of the epiglottis. An epiglottectomy by means of lateral pharyngotomy was performed but a local recurrence with cervical node metastases became manifest eight months after the initial operation. A total laryngectomy and neck dissection was followed by radiotherapy to the lower neck, but the patient died six months later of metastatic disease.

These two experiences show that the suitability for the performance of epiglottectomy in previously unsuccessfully irradiated cancers should be carefully evaluated. Uncertainty in defining the limits of the cancer because of submucosal extension, not grossly detectable, may predispose to an inadequate excision. Total laryngectomy and radical neck dissection is the procedure with greater safety, but further observation is required before rigid conclusions can be drawn.

FIG. 26—Gross specimen of carcinoma of infrahyoid portion of the epiglottis. Note free border of uninvolved mucosa entirely surrounding the epiglottic lesion. Tumor excised by lateral pharyngotomy and radical neck dissection. The patient was alive and well five years postoperatively.

3. A patient, aged 65, had a lateral pharyngotomy for removal of a lesion of the cartilaginous surface of the epiglottis with an uneventful recovery. Three years later he died of a coronary thrombosis. Examination of his larynx and neck, one week prior to death, showed no evidence of local or metastatic disease.

4. A patient, aged 62, developed ipsolateral metastasis 10 months after epiglottectomy. There was no evidence of any local recurrence in the larynx. A radical neck dissection was done and postoperative radiotherapy was administered to the neck. He is now free of disease three years after neck dissection and almost four years following the initial surgical intervention.

CERVICAL NODE METASTASES

Six patients with carcinoma of the epiglottis, including the infrahyoid portion of the cartilaginous surface were treated by epiglottectomy by means of lateral pharyngotomy and elective neck dissec-

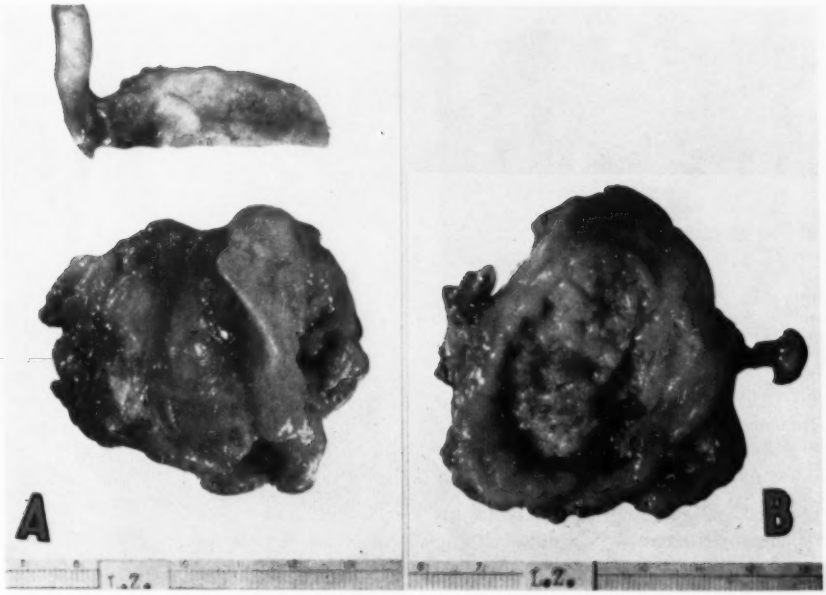


FIG. 27—Gross specimen of carcinoma of epiglottis.

A. Lateral view showing wide excision of pre-epiglottic space and hyoid bone. Excised upper half of thyroid lamina is seen above.

B. Laryngeal surface of tumor with free margin of mucosa on all sides. Neck dissection showed no palpable positive nodes. The patient was alive and well two and a half years postoperatively.

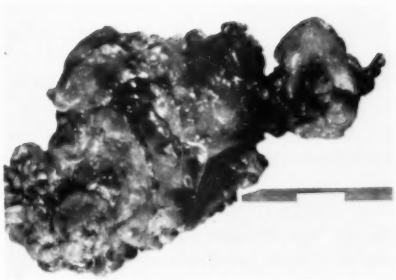

FIG. 28—Surgical specimen of carcinoma removed by epiglottectomy by means of lateral pharyngotomy with simultaneous radical neck dissection. Continuity of lymph-bearing structures of neck with the hyoid bone and thyrohyoid membrane is demonstrated.

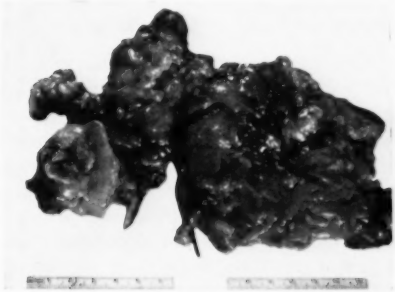

FIG. 29—Surgical specimen of carcinoma of epiglottis removed by epiglottectomy by means of lateral pharyngotomy and neck dissection.

FIG. 30—Anterior view of same surgical specimen as seen in figure 29. E—epiglottis. P—pre-epiglottic space. S—salivary gland. M—sternomastoid muscle.

FIG. 31—Sagittal section through epiglottic carcinoma showing invasion of pre-epiglottic space. Same specimen as figure 29.

tion. Although none had clinically evident metastases, two of these six had nonpalpable, microscopically positive nodes. All six are alive and well.

Of 10 patients with suprahyoid involvement treated by epiglottectomy by means of lateral pharyngotomy, two developed cervical node metastases within the first year. One was saved by radical neck dissection and radiotherapy.

The occurrence of nodal metatases from small lesions of the epiglottis is notoriously higher than with similar limited carcinoma of the vocal cord. Ogura[11,12] has shown that the size of the local lesion was unrelated to the first evident metastases and that a small carcinoma of the extrinsic larynx is more apt to metastasize than a large endolaryngeal growth.

Sixteen patients with carcinoma of the epiglottis were treated by partial or subtotal laryngectomy with a simultaneous neck dissection in six instances. Only one had local recurrence. This was in a patient who was previously unsuccessfully treated by radiotherapy. Four patients either had positive, nonpalpable nodes at the initial surgery or developed cervical metastases within the first year. In McCall's series of 42 patients[10] with carcinoma of the epiglottis, 16 had positive nodes preoperatively. Putney[15] recently stressed the high incidence of nodal metastases after total laryngectomy for extrinisc lesions without palpable nodes. Failures may be more attributable to cervical metastases than to local recurrence of the carcinoma.

The omission or performance of a simultaneous elective neck dissection with suprahyoid limited carcinoma of the epiglottis must be regarded as a calculated risk since, of 10 such cases, two developed cervical metastases within the first year. Alonso advised suprahyoid neck dissection in carcinoma of the epiglottis if the histologic classification of the lesion was type 3 or 4. McCall[10] made no such distinction. My present intention is to include an elective neck dissection with epiglottectomy by means of lateral pharyngotomy more often in the future.

## CONCLUSION

In the modern treatment of carcinoma of the larynx, the emphasis has been on more and more radical operations. Recent reports on the improved five-year survival rate after radical neck dissection combined with total laryngectomy seem to justify this policy. Neither the additional operative risk of simultaneous neck dissection nor its postoperative morbidity warrants the withholding of this procedure in the surgical treatment of extrinsic carcinoma of the larynx. Except for the associated scarring of the neck, the patient carries no harmful stigmata attributable to the radical neck dissection.

In dealing with the specific problem of the carcinoma of the epiglottis as previously outlined, radical and wider excision than is necessary for complete eradication must entail sacrificing the entire larynx, including the functional, uninvolved vocal cords. Total extirpation of the larynx must significantly alter the life habits of the patient in many respects. If unavoidable in order to effect a cure, total laryngectomy should be performed without hesitation. One wonders, however, if in selected instances the larynx might not be spared without assuming too great an additional risk to the patient's life. If the lesion be confined to the epiglottis as detailed, the need for the removal of the glottis as a precautionary measure is debatable; instead, more radical surgery could well be aimed at avoiding neck metastases.

In this small series of selected cases of carcinoma of the epiglottis, subtotal supraglottic laryngectomy or epiglottectomy via lateral pharyngotomy with simultaneous neck dissection has yielded promising results thus far. For such lesions, this procedure may prove more rewarding than total laryngectomy without neck dissection. The larynx could conceivably be spared in certain instances and at the same time, the chance of survival might be enhanced. Primary closure of the pharyngostomy has been obtained in every instance without resort to skin grafts. Except in patients over 70, disturbances of deglutition and respiration are transient.

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## DISCUSSION

JOSEPH H. OGURA, M.D., St. Louis: It is always a great pleasure to hear a presentation from Dr. Som, because he again has carefully and meticulously described his method for handling a select group of laryngeal cancers. I congratulate him on his excellent presentation on this timely subject. He has made many important points, with most of which I am in complete agreement. We differ only in some minor points and surgical approach to the same problem.

Otolaryngologists who perform laryngeal surgery are in the best position to decide, after careful clinical, tomographic, laryngographic and laryngoscopic examination, which lesions are best suited for this operation. Dr. Som's series and my series show that in these selected instances local recurrences in the remaining larynx must be rare, and failures are due more often to metastatic disease. To me this is tantamount to stating that total laryngectomy is not only contraindicated but an unnecessary disfiguring operation.

In my experience the clinical evaluation of the extent of the tumor can be greatly aided by the use of contrast dyes. The use of Dionosil in over 250 varying problems of laryngeal disease has not only helped us define the inferior margin of the cancer but showed the mobility of the true cords.

I believe the most ideal candidates for this operation have lesions involving the free border of the epiglottis with the main bulk of the tumor on the laryngeal surface. Ideally the inferior border of the tumor should not extend below the petiole. While I have stated that the free surface of the false cord should be free of tumor as well as the arytenoid, the involvement of these structures by no means contraindicates this approach. There should be a consent for total laryngectomy if there is any doubt about the margin of safety with the anticipated supraglottic subtotal laryngectomy. This can only be determined at the time of exploratory pharyngotomy.

Dr. Som's method for primary closure without the use of skin grafts and without the development of fistula deserves great merit. I presently prefer the use of skin grafts, particularly in very extensive lesions, to reconstitute a more normal laryngopharynx.

I am not always certain that the preservation of one superior laryngeal nerve helps shorten the time of the reconstitution of deglutition, since preservation of this nerve does not parallel early deglutition. Patients with lesions of the lateral hypopharyngeal wall, when the epiglottis is not removed but excision of tumor and neck dissection is performed in continuity with immediate reconstruction, have as great or sometimes longer period of time before relearning swallowing. Furthermore the preservation of the false cords in addition to the preserved superior laryngeal nerve does not materially help in speeding deglutition. Lesions of the vallecula and the lingual surface of the epiglottis would be a specific instance where preservation of the false cord is possible. The problem of swallowing is not necessarily related to the preservation of one superior laryngeal nerve, but is more related to the extent of surgical interference of the laryngopharynx and the process of healing. The time the patient needs to relearn swallowing is shortened proportionately; swallowing is established according to how much the patient works at deglutition during the postoperative period. As long as the laryngopharynx is filled with exudate during the healing phase, the patient will have difficulty with deglutition. An epithelized laryngopharynx is essential for this.

I believe that it is a safer and sounder surgical principle to remove both false cords by approaching just superior to the anterior commissure of the true cords by the transverse thyrotomy method. Only in this manner is the entire pre-epiglottic space removed. This is particularly true with the infrahyoid lesions of the epiglottis. In our small series, we have been impressed by the frequency of carcinoma-in-situ near the transected border of the false

cord and ventricle. I also believe that, once the laryngopharynx has been opened, the operator's finger or surgical instrument should not come into contact with the tumor. Local recurrences by accidental implantation will thus be avoided. To date, I have had no local recurrence in my series, and have not had to resort to total laryngectomy in any instance.

It is gratifying to note that impalpable metastases were found in two of six elective neck dissections in Dr. Som's series, and it is his conclusion to perform more elective neck dissection with epiglottectomy. In our series of supraglottic subtotal laryngectomy and radical neck dissection, all patients had unilateral neck dissection, and one patient had a one stage bilateral neck dissection. There were eight positive nodes in eighteen cases. Of the original reported series, three had palpable nodes, and five of fifteen had impalpable metastases. Two of the entire group of eighteen had subsequent radical neck dissection in the remaining side. It is now nearly four years since the first operation in this series. Since it is agreed by many that the epiglottic lesions are particularly unfavorable, and it is metastatic disease that determines survival, I shall continue to perform elective neck dissection on one side. If bilateral suggestive nodes are present, then bilateral one stage neck dissection is indicated. In unilateral neck dissection cases, this reduces the followup observation to only one side of the neck.

No major operative procedure is without unfortunate complications. Operating upon an older debilitated person when aspiration pneumonia might result in a later total laryngectomy, in my opinion, does not militate against the use of this surgical procedure. I have operated upon a person as old as the patient cited by Dr. Som, but I have not found it necessary to perform secondary total laryngectomy.

The patient must be prepared before the operation to relearn swallowing. Following the operation I always try to have another patient with the same operation visit the patient. After watching these patients go through this re-education phase, I believe that to relearn swallowing is as difficult for some as it is for some to learn esophageal speech following laryngectomy.

This approach opens up new avenues for patients suffering from cancer who greatly fear a permanent tracheotomy with the attendant difficulties. The more extensive lesions of the base of the tongue, in the vallecula and epiglottis are suitable for this approach. Furthermore I have recently extended the limits of operation inferiorly to include not only the epiglottis, aryepiglottic fold and false cords but also the entire arytenoid eminence. The latter removal will fix the true cord band, but even in this instance the patient can swallow. On the other hand, when a lesion is on the posterior one third of the tongue but does not involve the epiglottis, I prefer to remove the lesion and neck dissection by means of the mandible osteotomy approach.

Since local recurrence is rare and sufficient time has elapsed in the follow-up period in Dr. Som's series and my series, I fail to see why total laryngectomy should be continued or performed on these selected instances of epiglottic cancer. I would like to emphasize the word *selected*, and that this operation be not contemplated in the usual extensive forms of epiglottic cancer where the true cord is invaded and total laryngectomy with neck dissection is indicated. These patients with subtotal laryngectomy are a great deal happier, have been returned to society, and can resume normal activities, have a good voice without attendant difficulties with a permanent tracheotomy, swallow well and without jeopardy to their life.

DR. SOM: I want to thank Dr. Ogura for his kind words and for his excellent presentation of the subject. I must confess that Dr. Ogura is much more heroic in his approach to this lesion than I have been; but I am willing to learn more about this and perhaps treat more involved cases.

If you are reconciled to sacrificing both internal laryngeal nerves, then there is certainly no harm in excising a small portion of the upper part of the thyroid cartilage on both sides. But you are certain then that you have transected both internal laryngeal nerves.

In the process of alimentation, I found it to be a great help to the patient on the fifth or sixth postoperative day to lean forward to the uninvolved side as he begins to swallow semi-solid food.

The process of swallowing is simply one of re-educating the act of deglutition; and it is helped by first swallowing solids, and then swallowing liquids.

I have not treated the extensive lesions that Dr. Ogura has treated; but I think his successful experiences with his more extensive operation should make us think that perhaps the scope of this operation is much wider than is presently adhered to.

# SURGICAL PATHOLOGY OF THE MIDDLE EAR IN 3-D

J. Brown Farrior, M.D.
TAMPA, FLORIDA

This three-dimensional study has demonstrated many variations in the diseased tissue of the middle ear. Cases have been selected to illustrate central perforations, cholesteatomas, and the multiple variations of otosclerosis. This paper is divided into two parts: in the first, I will discuss chronic otitis media, and in the second I will discuss the anatomy and disease changes of the stapes which influence stapes operability.

## I.

## Chronic Otitis Media: Indications for Tympanoplasty

Recent advances in endaural surgery and tympanoplasties have completely changed some of the classic teachings in otologic surgery. Formerly standard, clear-cut indications existed for the simple mastoidectomy, the modified-radical mastoidectomy and the radical mastoidectomy. The primary goal of this classic operation was to eradicate the disease and to obtain a dry ear.

The tendency has been to postpone surgical treatment of the ear until a functional hearing loss occurred; today operations can be performed early in the disease process to preserve or restore hearing. With this advancement in otologic surgery, it has become more and more important to recognize minute variations in the diseased tissue of the middle ear.

From the Southern Foundation of Better Hearing, Tampa, Florida.

Presented at the Sixty-Second Annual Session of the American Academy of Ophthalmology and Otolaryngology, Oct. 13-18, 1957, Chicago.

Detailed interpretation of the existing pathologic changes is the basis of sound surgical judgment. I will describe a series of cases to illustrate this point.

### CENTRAL PERFORATIONS

We have always been taught to treat central perforations conservatively; small perforations can be closed during office treatment. Large perforations can be closed by means of tympanoplasty, restoring the ear to near anatomic and functional normalcy. Surgical operation on these central perforations has revealed many underlying pockets of cholesteatoma. Technically the lasting success of tympanoplastic surgery is dependent upon the removal of all squamous epithelium from the middle ear, the rim of the drum, and the adjacent outer surface of the drum and adjacent canal wall, which are to receive the graft. Either a thick, split graft or a full-thickness postauricular graft will suffice to close these central perforations. I prefer the full-thickness graft because it is a little less likely to develop central necrosis. When possible I use a pedicle graft rotated from the canal, as advocated by Bell.[2] I follow the principles of Wright and Guilford in applying minimal pressure to hold the graft in position.

*Case 1—Central perforation; myringoplasty (type I tympanoplasty)*[15]

[Slide 1] This case illustrates a large dry central perforation of the tympanic membrane with closure by a myringoplasty. Microscopic examination of the middle ear reveals almost normal mucous membrane over the promontory. There is no scar tissue over the round

window. The normal stapes is visible. Only a 2 mm. to 3 mm. margin of the drum is present, but this contains the normal fibrocartilaginous ring of the annulus. The handle of the malleus is visible anteriorly. The malleus and ossicular chain are freely movable as determined by the acoustic probe, the application of a prosthesis and by palpation. All of these factors make this an ideal case for myringoplasty.

[Slide 2] The perforation, drum, and canal are prepared for myringoplasty by the removal of all squamous epithelium. The squamous epithelium is removed by first making a small incision in the margin of the perforation and stripping the circumference of the perforation. Second, an incision is made from the margin of the perforation outward for 8 mm. in the posterior part of the canal wall. This, and the following incision, is made only through the squamous epithelium. The third incision is completely annular, 8 mm. peripheral to the drum. With the cotton-tipped suction-dissector, the epithelium is dissected from the canal wall, the fibrocartilaginous rim of the annulus, and the drum remnant. The entire area is searched under the microscope and residual shreds of epithelium are removed.

[Slide 3] A full-thickness postauricular graft has been sutured over a tympanic splint. The splint is a piece of photographer's grade synthetic sponge of the size and shape of the canal. The graft is sutured over this with fine intestinal chromic catgut and the corners cut away.

[Slide 4] The graft and splint are placed in position and the sutures removed. The sponge is moistened; the expansion holds the graft in position with minimal pressure.

[Slide 5] The resultant postoperative tympanic membrane has a dull but near-natural appearance. Hearing is improved 24 decibels.

### CENTRAL PERFORATION WITH CHOLESTEATOMA

*Case 2—Central perforation with cholesteatoma; type III tympanoplasty*

[Slides] This case and its management are similar to case 1, except that squamous epithelium appears on the superior surface of the stapes and the adjacent fallopian canal.

Tympanoplastic surgery should include a careful search for beginning cholesteatoma.

*Case 3—Central perforation with cholesteatoma; type III tympanoplasty and modified radical mastoidectomy*

[Slides] In one case of central perforation, squamous epithelium completely surrounded the malleus and extended medially and upward between the malleus, incus, and over the cochlear-form process. A remnant of a moveable stapes was present. At the completion of the modified radical mastoidectomy it was necessary to place Gelfoam in the middle ear to preserve the air space over the round window. The type III tympanoplasty improved hearing 28 decibels, giving the patient, a 48 year old woman, her best hearing since she had had measles at age 5 years.

### SMALL ATTIC PERFORATION WITH EXTENSIVE CHOLESTEATOMA

*Case 4—Type IV tympanoplasty*

[Slides] This case demonstrated the insidious damage from cholesteatoma behind minute perforations.

The posterior superior perforation was 1 mm. and the remainder of the

drum was dull but intact. The elevation of annulus during the exploratory tympanotomy revealed that the cholesteatoma extended downward, destroying the stapes and covering the round window. The modified radical mastoidectomy revealed cholesteatoma forward under the malleus and above, destroying part of the incus.

The cholesteatomatous sac was removed from the middle ear after the modified radical mastoidectomy. This revealed gelatinous fluid in the middle ear; the result of a long untreated secretory otitis media. I am often impressed with the role of secretory otitis in the pathogenesis of cholesteatoma.[1]

A type IV tympanoplasty did not improve hearing.

### MIDDLE CHOLESTEATOMAS

*Case 5—Cholesteatoma in middle ear; type II tympanoplasty*

[Slides] In this instance of a small posterior superior perforation, elevation of the fibrocartilaginous ring of the annulus and exploratory tympanotomy revealed a cholesteatomatous sac, filling the posterior half of the middle ear cavity. Removal of the sac of cholesteatoma revealed gelatinous fluid in the middle ear, a normal round window, and a freely moveable incus and stapes. A modified radical mastoidectomy and type II tympanoplasty improved hearing 22 decibels.

*Case 6—Unsuccessful type IV tympanoplasty; fenestration advised*

[Slides] In another instance of a small attic perforation, the cholesteatoma extended into the middle ear and destroyed the incus and stapes.

A modified radical mastoidectomy and type IV tympanoplasty gave a dry ear, but no hearing improvement. A fenestration operation is planned.

*Case 7—Type III tympanoplasty; tympanostapediopexy*

[Slide] A type III tympanoplasty and modified radical mastoidectomy were performed in this case; after the operations the tympanic membrane was attached to the head of the stapes and extended upward over the fallopian canal. Juers has shown that tympanostapediopexy results in nearly normal hearing.[10]

### TRAUMATIC MARGINAL PERFORATION

*Case 8*

[Slide] The patient had had a posterior superior perforation for four years as a result of a foreign body. The perforation did not respond to one year of office therapy.

The perforation was closed with a pedicle flap from the canal wall after denuding the margins of the perforation and the adjacent drum. The operation resulted in the restoration of normal hearing.

### SUPPURATIVE LABYRINTHITIS IN GERIATRICS

*Case 9—Suppurative labyrinthitis; labyrinthotomy required*

[Slide] A 68 year old woman with diabetes developed diffuse suppurative labyrinthitis with meningeal signs after years of conservative therapy for extensive cholesteatoma.

A radical mastoidectomy and labyrinthotomy were required. In addition to the fistula in the horizontal canal, the fallopian canal was eroded, requiring partial decompression.

In Florida, the incidence of complications is high in long-treated cholesteatomas of geriatric patients. Conservative therapy is useful in the treatment of cholesteatoma but it must include thorough cleansing with medication, attic irriga-

tions and suction.[1] Conservative therapy over a long period is indicated when

1. The attic is wide open.

2. There is no clinical evidence of inaccessible pockets of cholesteatoma which might produce progressive hearing loss or complications.

3. There is no roentgenographic evidence of inaccessible pockets of cholesteatoma.

SUMMARY

Large central perforations of the tympanic membrane were formerly treated conservatively; with tympanoplasty (myringoplasty) many of the membranes can be restored to near anatomic and physiologic normal.

The tendency was to postpone surgical operation on small cholesteatomas until the hearing loss was significant; today, tympanoplasties offer a method of preserving and restoring hearing. The best time for tympanoplastic surgery is before the damage is done.

In spite of antibiotics and modern surgical techniques many complications still require old-fashioned complete mastoidectomy. In Florida, these complications are frequent among geriatric patients.

## II.

## Otosclerosis of the Stapes: Pathologic Indications for Mobilization and Fenestration Surgery

Success of surgical treatment of the stapes depends upon the type of anatomic development and the pathologic involvement. Mobilization surgery is more satisfactory if the footplate of the stapes is relatively superficial; if the footplate is deeply placed, the crura tend to become involved in the otosclerotic process.

Otosclerosis may involve varying degrees of the footplate, crura, or even the head and neck of the stapes. Simple footplate involvement reacts very favorably to mobilization surgery; complete otosclerotic involvement will not respond to the mobilization operation but is a positive indication for the fenestration operation. Excavation of the oval window is indicated for some types of otosclerotic involvement; other types of involvement necessitate the fenestration operation.[14]

### ANATOMIC VARIABLES

The position of the footplate may influence the result of surgical treatment of the stapes (chart I).

CHART I

| ANATOMIC VARIABLES | OPERABILITY (Prognosis) |
|---|---|
| Depth of the Footplate of Stapes | |
| 1. Superficial | Favorable |
| 2. Moderately superficial | Less favorable |
| 3. Moderately deep | Unfavorable |
| 4. Deep | Unfavorable |
| Angulation of Crus | |
| 1. Upright | Most favorable |
| 2. Downward tilt (free) | Less favorable |
| 3. Downward tilt (fixed) | Unfavorable |
| 4. Upward tilt | Less favorable |
| Strength of Crus | |
| 1. Weak | Vulnerable |
| 2. Medium | Moderately vulnerable |
| 3. Strong | Invulnerable |
| 4. Atrophic | Inoperable footplate |

If the footplate of the stapes is placed very superficially, the otosclerotic involvement will be thin and will not involve the crura (fig. 1). If, on the other hand, the footplate of the stapes is in a deep niche, the crura tend to tilt downward, easily contacting the inferior lip of the oval window, and are predisposed toward otosclerotic involvement (fig. 2) or complete otosclerotic filling of the oval window niche. When the footplate is deep, the crura will occasionally tilt upward to contact the fallopian canal (fig. 3). As the disease progresses the chance of successful surgical treatment decreases.

FIG. 1—When the footplate of the stapes is superficially placed and the crura are upright, the otosclerosis tends to remain localized to the level of the footplate. This figure illustrates a superficially placed footplate with upright crura and a small focus of circumscribed anterior footplate otosclerosis. For stapes surgery this is the most favorable anatomic development and pathologic involvement.

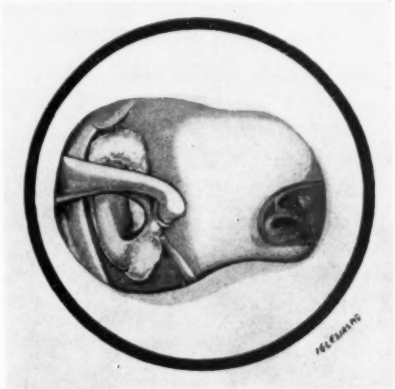

FIG. 2—When the footplate of the stapes is deeply placed in the oval window niche, the crura tend to tilt downward and contact the inferior lip of the oval window niche. The contact predisposes toward otosclerotic fixation of the crura and such crural otosclerosis alters the result of surgical treatment of the stapes. As refixation is prompt, bicrural otosclerosis is beyond the limits of manipulative operations on the stapes.

FIG. 3—When the footplate of the stapes is deeply placed in the oval window niche, the crura will sometimes tilt upward to contact the fallopian canal. This contact predisposes toward otosclerosis or postmobilization scar fixation between the crura and the fallopian canal.

The strength of the crura does not greatly affect the result of surgical treatment of the stapes when the footplate is treated directly. True, if the crura are weak or friable this predisposes toward their fracture, but too much pressure on the crura is a surgical error. Atrophy of the crura is generally associated with complete footplate otosclerosis which

CHART II

| PATHOLOGIC VARIABLES | OPERABILITY |
|---|---|
| *Location of Otosclerosis* | |
| Type | |
| 1. Circumscribed | Favorable |
| 2. Diffuse | Unfavorable |
| Footplate | |
| 1. Anterior | Favorable |
| 2. Posterior | Favorable |
| 3. Superior marginal | Unfavorable |
| 4. Inferior marginal | Unfavorable |
| 5. One fourth | Favorable |
| 6. One half | Less favorable |
| 7. Three fourths | Unfavorable (thick) |
| 8. Complete (thin) | Favorable |
| 9. Complete (thick) | Inoperable |
| Crus | |
| 1. Anterior | Favorable |
| 2. Posterior | Unfavorable |
| 3. Both | Inoperable |
| 4. Apical | Inoperable |
| 5. Cervical | Inoperable |
| Round Window | |
| 1. Marginal without closure | Favorable |
| 2. Partial closure | Unfavorable |
| 3. Complete closure | Inoperable |
| *Character of Otosclerosis* | |
| Thickness of Stapes and Oval Window | |
| 1. Very thin | Favorable |
| 2. Thin | Favorable |
| 3. Moderately thick | Unfavorable |
| 4. Thick | Inoperable |
| Color | |
| 1. White | Favorable |
| 2. Nearly white | Favorable |
| 3. Pink | Unfavorable |
| 4. Red | Inoperable |

cannot be surgically treated. Translucent red crura are the most friable while white crura will withstand the greatest amount of manipulation. A classification of crural strength is included in chart I.

## PATHOLOGIC VARIABLES

The location and character of the otosclerosis greatly affect the results of surgical treatment of the stapes (chart II).

### *Location of Otosclerosis*

Otosclerosis may involve the footplate, the crura or the neck of the stapes, or the round window.

The two basic types of otosclerosis are circumscribed and diffuse.[6] Circumscribed otosclerosis responds best to mobilization surgery if the location of the disease and the anatomy of the ear are conducive to treatment. Surgical treatment of the stapes rarely stops diffuse otosclerosis which extends over the entire promontory. Eventually we may learn that circumscribed and diffuse otosclerosis are separate diseases.

Clinical experience shows that circumscribed anterior footplate otosclerosis reacts favorably to mobilization surgery (fig. 4); posterior footplate otosclerosis reacts just as favorably, but occurs less frequently. Superior and inferior marginal otosclerosis react less favorably because they tend to involve the sides of the crura. The degree of involvement of the footplate is significant and its influence upon the result of surgical treatment is intimately associated with the thickness of the otosclerosis and crural involvements. Complete otosclerosis of the footplate can be surgically treated as long as the annulus of the footplate remains well defined and the crura are not involved; this condition is found in thin, white otosclerosis (fig. 5).

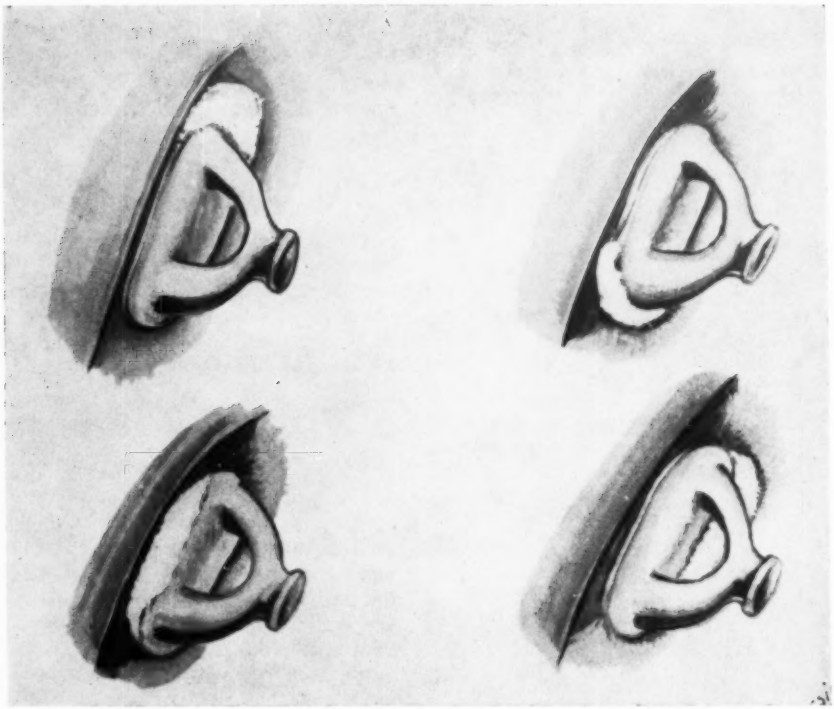

FIG. 4—Footplate otosclerosis. Circumscribed footplate otosclerosis responds well to the stapes mobilization operation. The otosclerosis tends to remain at the level of the footplate when the footplate is superficial and the crura do not contact the margins of the oval window niche. Anterior footplate (upper right) and superficial marginal (lower left) otosclerosis are present occasionally. Inferior marginal (lower right) otosclerosis is frequent and is usually a continuation posteriorly of anterior footplate otosclerosis.

When the otosclerosis is thick enough to obliterate the annulus of the footplate, the stapes cannot be surgically treated.

Otosclerosis may involve one or both crura; as previously stated, crural otosclerosis is most likely to occur in the deeply placed footplate with tilted crura. Anterior crural otosclerosis (fig. 6) reacts favorably to the mobilization operation but refixation of the footplate is likely to occur unless an anterior crurotomy is performed.[5] Posterior crural otosclerosis has not been found as an isolated pathologic entity.

Bicrural otosclerosis has occurred most frequently with inferior marginal otosclerosis and occasionally with superior marginal otosclerosis (fig. 6). In each instance there has been refixation of the stapes after successful complete mobilization. I think bicrural otosclerosis is beyond the limits of the present mobilization operation and should be considered an indication for the fenestration operation. Otosclerotic fixation involving the apex of the two crura and the neck of the stapes also is beyond the limits of the present mobilization operation.

Bicrural otosclerosis with an area of normal or nearly normal footplate may be the type of otosclerosis that will respond to mobilization or excavation of the footplate and the application of prosthetic crura.

Complete otosclerotic closure of the round window is a contraindication to mobilization or fenestration surgery. The patient can still obtain maximum benefits from surgical treatment when closure of the round window is partial or almost complete; however, the long term result is not favorable. Round window closure has occurred without stapes fixation; however, usually diffuse otosclerosis makes successful surgical treatment of the stapes impossible (fig. 5).

*Character of Otosclerosis*

The thickness of the otosclerosis alters the results of surgical treatment of the stapes. Thin circumscribed otosclerosis reacts most favorably to the mobilization operation while thick diffuse otosclerosis reacts the least favorably. As long as the margin of the annulus of the

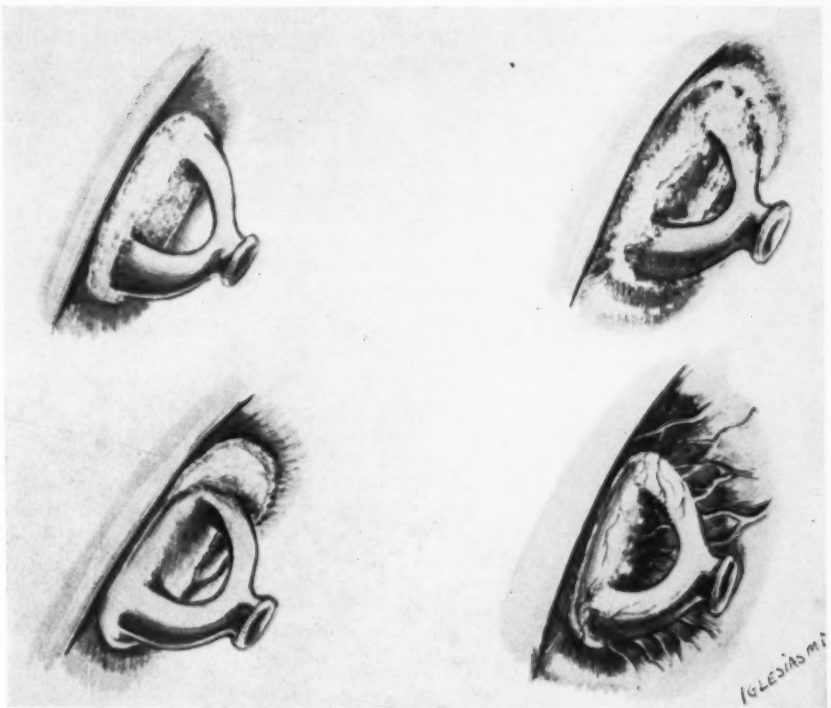

FIG. 5—Character of otosclerosis. The thickness and the color (vascularity) of the otosclerosis alter the results of surgical treatment of the stapes. Complete footplate otosclerosis still may be treated surgically when thin, when the annulus is well defined and when the crura are not involved (upper left). However, when the otosclerosis of the complete footplate and oval window niche becomes thick enough to obliterate the annulus (upper right) of the footplate the stapes then cannot be surgically treated.

Circumscribed white, avascular otosclerosis (lower left) is most responsive to surgical treatment of the stapes, while diffuse, red, vascular otosclerosis (lower right) will usually cause refixation even after complete mobilization.

footplate is not obliterated by the disease and the crura are free, the chance of successful surgical treatment is reasonably good (fig. 5). However, when the otosclerosis thickens to obliterate the annulus or fill the oval window, the stapes cannot be surgically treated. This is most frequent in diffuse otosclerosis. In such cases, there is no need to jeopardize inner ear function with excessive surgical treatment of the footplate when the disease has progressed beyond the limits of stapes surgery.

The result of surgical treatment of the stapes varies with the color of the otosclerosis. White (avascular) otosclerosis is a favorable indication of lasting results in mobilization surgery, while in red (vascular) otosclerosis mobilization can be accomplished but there is almost always refixation. The color may vary from white, to off-white, to pink, to red.

### THE AUDIOGRAM

Anterior footplate and anterior crural otosclerosis tend to produce a flat or ascending air conduction curve and a nearly normal bone conduction curve. As the fixation of the footplate progresses, the Carhart notch develops.[13] Loss of high tones indicates complete

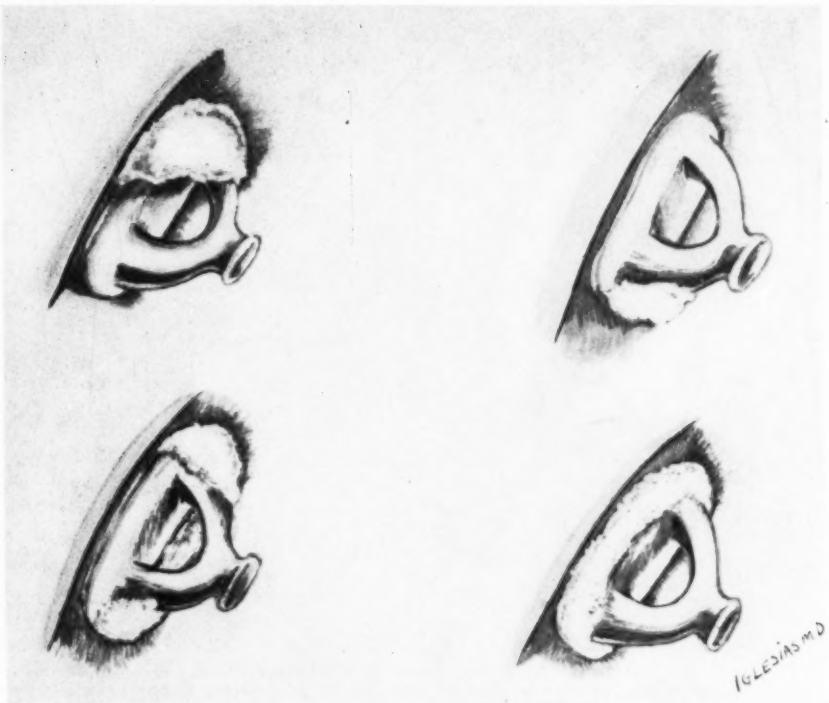


FIG. 6—Crural otosclerosis. Crural involvement by the otosclerotic process greatly alters the operability of the stapes. Anterior crural (upper left) otosclerosis is frequent and is an indication for anterior crurotomy and posterior footplate mobilization. Posterior crural (upper right) otosclerosis has not been found as an isolated entity. Bicrural otosclerosis is found with some frequency and is associated with inferior marginal (lower left) and superior marginal (lower right) otosclerosis in a deeply placed footplate.

footplate fixation. I have seen a number of cases of flat audiogram curves and complete footplate fixation. But the flat curve persists only so long as good, strong, free crura are transmitting vibrations to the fixed footplate.

When the sides of both crura become fixed and they are no longer capable of transmitting to the footplate, there is loss of the high tones (2000, 4000 and 8000 cps) and progression of the Carhart notch, with diminution of the air bone gap at 2000 cps. This has occurred when crural fixation was associated with complete footplate fixation; more important, this has occurred in combined marginal and bicrural otosclerosis with incomplete footplate fixation but complete loss of crural transmission. I now think that the audiogram curve tends to remain flat and speech discrimination good as long as strong free crura are transmitting vibrations to the footplate, even though the footplate itself is completely fixed.

This association of the type of otosclerotic involvement and the high tone loss does not apply to independent nerve deafness.[4] For example, when there is an independent nerve loss for the high tones from one cause (acoustic trauma, presbycusis, etc.) and the patient has otosclerosis causing the loss of low tones, the association of high tone loss with progression is not true. This type of independent high tone loss does not indicate alteration in the operability of the stapes.

The patients with combined oval and round window closure have been severely deaf and audiometrically have shown only a little residual air conduction and bone conduction for the lower tone frequencies. However, such an audiogram does not always indicate round window closure.

## MISCELLANEOUS LESIONS

Our knowledge of the variations of otosclerosis has been limited to a relatively small number of autopsy specimens.[3,6-9,11,12] Today the operating microscope and photographic slides have increased our knowledge of otosclerotic disease and the effect on hearing. They have revealed many lesions which simulate the otosclerotic type of deafness or alter the operability of the stapes. These lesions include mucous membrane webs; fibrous adhesions; abnormalities of the footplate, anterior crus, posterior crus, stapedius, incus, and malleus; and systemic diseases.

Mucous membrane webs frequently occur over and around the stapes and do not greatly alter the result of surgical treatment. I used to destroy these mucous membrane webs to see the footplate more clearly; however, I now believe this results in greater postoperative scar formation and at present prefer to operate through or around these webs. Dense scar tissue does alter the operability of the stapes; where possible I remove or shunt these fibrous adhesions, but they tend to recur as they do elsewhere in the body.

Schuknecht has reported a case of fixation of the stapedius tendon. Odess reports a case of malleable incus. All of us have seen fixed ossicles in congenital deformities, infections and in arthritis. I have one case of a large blue footplate with apparent congenital absence of the annulus of the footplate. The list of miscellaneous lesions continually grows.

## STATISTICAL REPORTING

Any statistical reporting of results of mobilization surgery should include the type of anatomic development and the type of disease present. Only by such a basic classification can we learn which operations, and which techniques, will

give lasting results in individual circumstances.

Certainly the diagnosis "otosclerosis" alone is inadequate for study and future reference. The diagnosis should include a description of the anatomic and pathologic findings and should be complete, as:

1. Otosclerosis, circumscribed, thin, white, anterior footplate, three-fourths blue, inferior marginal, favorable.

2. Stapes, fixed, deep, downward tilt.

3. Round window, normal, webs.

### CLINICAL COMMENTS

1. Stapes mobilization is the operation of choice for early and moderate circumscribed otosclerosis.

2. In bilateral otosclerosis, the anatomy of the stapes and extent and type of the disease of the two ears are similar in type although the disease may vary in degree.

3. Success of the stapes mobilization operation on one ear is an indication for mobilization of the stapes of the opposite ear.

4. If the stapes mobilization has been primarily successful but the extent of the disease indicates that the stapes will become refixed, the patient is advised that he will probably need a fenestration operation. The surgeon may set a tentative date about three months hence.

5. (a) If the first stapes mobilization operation on the poorer ear failed and the present extent of the disease is unknown, a fenestration operation may be advised.

(b) A subsequent stapes mobilization operation on the opposite ear depends on results of examination at the time of the fenestration on the first ear.

6. If the stapes mobilization operation on the better ear failed and the extent of the disease is unknown, an exploratory tympanotomy is done on the opposite ear and either a mobilization or a fenestration operation performed.

7. A positive Schwartze sign is probably a contraindication to mobilization surgery; certainly it is a contraindication to a "solo" mobilization.

8. Crurotomy should accompany mobilization surgery in treating anterior crural otosclerosis in order to prevent refixation.

9. Bicrural otosclerosis is a contraindication to mobilization surgery. However, in the severely deaf some improvement may result from anterior and posterior crurotomy, and mobilization or excavation of the footplate, and the application of prosthetic crura.

10. Bicrural otosclerosis is clinically indicated by high tone deafness.

11. Complete otosclerosis of the footplate may be evidenced by a flat audiogram curve if there is no crural fixation, until the otosclerosis becomes too thick and the crura too weak to transmit sound.

12. Bicrural otosclerosis with round window closure is indicated clinically by very severe nerve loss.

13. Refixation of the stapes may result from inadequate surgical treatment.

14. Most instances of refixation of the completely mobilized stapes result from unsatisfactory healing processes.

15. A second operation on the stapes is indicated only when all conditions are favorable and initial mobilization has been incomplete; it is contraindicated when either primary otosclerosis or secondary postmobilization cicatrization is present.

CHART III

| EXTENT OF DISEASE | OPERATION INDICATED |
|---|---|
| 1. Anterior footplate otosclerosis; superficial stapes | Direct footplate mobilization; pick anterior |
| 2. Anterior footplate otosclerosis; deep stapes | Indirect stapes mobilization; pressure on incus |
| 3. Anterior crural otosclerosis | Anterior crurotomy; posterior footplate mobilization |
| 4. Bicrural otosclerosis; some normal footplate | a. Footplate mobilization; bicrural<br>b. Footplate mobilization; artificial crura |
| 5. Complete footplate otosclerosis; thin (annulus visible superficial footplate) | Circumferential footplate mobilization |
| 6. Complete footplate otosclerosis; thick (annulus not visible) | Fenestration |
| 7. Obliteration of oval window niche | Fenestration usually required; if there is a small area of normal footplate, bicrural footplate mobilization or artificial cruralization may be attempted |

16. Stapedial footplates so involved that they cannot be mobilized or excavated are an unequivocal indication for the fenestration operation.

17. Adequate exposure and magnification are advocated to determine the pathologic and anatomic limitations of surgical treatment of the stapes.

18. Surgical judgment is required to evaluate stapes operability in order to apply the appropriate surgical technique (chart III).

## SUMMARY

1. The extent and type of the disease indicate whether the surgeon should perform a stapes mobilization operation or a fenestration operation.

2. The result of surgical treatment of the stapes depends upon the type of anatomic development and the degrees of pathologic involvement and the combinations of these variables.

3. There is often a direct correlation between the severity of the deafness, the pathologic involvement and the result of surgical treatment of the stapes.

4. Any classification of results of stapes surgery should be based upon the type of anatomic development and the type of pathologic involvement. In this way we can decide when to treat the stapes surgically.

5. The stapes mobilization operation is a reliable surgical procedure; it is useful in treating both mild and moderate cases of otosclerosis.

6. The fenestration operation is indicated when the antomic development and pathologic involvement preclude success of the stapes operation.

7. If the surgeon strives to obtain the maximum percentage of mobilization in all types of pathologic involvement, he will jeopardize the functions of many inner ears.

8. Extensive otosclerotic involvement of the crura is the most frequent cause of refixation after complete stapes mobilization.

9. Inoperability of the stapes may result from extensive otosclerosis, vascular otosclerosis, postmobilization cicatrization, adhesive processes, or a combination of any of these with abnormal anatomic development.

10. Inoperability of the stapes is suspected if there is a positive Schwartze sign, if there is a high tone loss, or if the patient is very hard of hearing (50 db or more).

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# THE PATHOGENESIS OF ACUTE EXTERNAL OTITIS

EDLEY H. JONES, M.D.
VICKSBURG, MISSISSIPPI
*and*
TOM D. NORMAN, M.D.
JACKSON, MISSISSIPPI

BY INVITATION

RECENTLY we made a preliminary report on our studies of the pathogenesis of dermatoses of the external auditory canal, presenting 20 cases of acute diffuse external otitis due to deep infections, 12 of which were complicated with furuncles.[1] We have continued our studies and can now report an additional 32 cases, from 30 patients.

## MATERIALS AND METHODS

Three of these patients were seen in the University Outpatient Clinic and two were referred from the Kuhn Memorial Outpatient Clinic; all of the others were private patients. Insofar as possible, these studies were made on consecutive cases, excepting only those cases involving young children and apprehensive patients. When clinically indicated, smears were made for bacterial and cytologic examination, and cultures were made of bacterial and suspected fungal infections. White blood counts were routinely made, and red blood counts, hematocrits and hemoglobin determinations were made when indicated.

A biopsy was made with the patient's knowledge and permission. After preparing the skin with 95 per cent alcohol, approximately 0.5 ml. of 2 per cent hylocaine with 1:50,000 Epinephrine Hydrochloride solution was slowly injected 3 to 5 mm. anterior to the chosen site; after five minutes an elliptical V-shaped section approximately 2 to 3 mm. wide and 5 to 6 mm. long was removed. This section extended through the epithelium and into the subepithelial tissue but not to the cartilage. Immediately following removal of the tissue the external canal was packed with cotton for hemostasis; occasionally application of 1:1,000 Epinephrine Hydrochloride solution or Monsell's solution was necessary. A pack saturated with some medication (Cresatin, Biomydrin Otic, Otobiotic, Neo-Delta-Cortel, hydrocortisone suspension, Aerosporin, or Cortisporin) was then inserted and left in place for two days, and the same medication was prescribed to keep the pack moist. (Our best results were obtained with Cortisporin.) Adequate antibiotics or chemotherapy and adequate sedatives were prescribed along with any other indicated supportive measures.

The tissue removed for biopsy was fixed in 10 per cent formalin; sections 5 microns thick were made, semiserially and serially. Slides of all cases were routinely stained with hematoxylin and eosin, but slides from some cases were also stained by MacCallum's modification of Goodpasture's Gram stain.

From the Division of Otolaryngology, Department of Surgery, and the Department of Pathology, University of Mississippi Medical Center, Jackson, Mississippi. Dr. Norman is now located at the University Medical Center, Little Rock, Arkansas.

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We concluded our recent report by stating that we felt that additional studies from other geographic areas were indicated, and we invited other otologists and pathologists to join us in continuing these investigations. During the discussion, the question of the patient's safety and welfare was raised; again it seems appropriate to discuss that very important matter at this time. If a small, sharp needle is used and the anesthetic is injected slowly, there is very little pain, even in the very acute cases. Within a few minutes most patients experience considerable relief from pain. A new Bard-Parker 15 blade should be used for each procedure and the incisions made with a gentle, slicing motion with only the slightest pressure. Very few of our patients have complained of any pain, except for the injection, and many have remarked they did not feel any pain while the incisions were made. Here we would like to emphasize that many of these cases were complicated with furuncles; and that a basic surgical principle in the treatment of furunculosis is incision and drainage, preferably with a crucial incision. Obviously the external ear canal does not lend itself to a crucial incision, and just as obviously a "trough" incision, which provides material for biopsy, will provide adequate drainage. Of the more then 60 biopsies taken to date, only one patient experienced any difficulty. That patient had a very severe reaction to a Cresatin pack, which could have occurred had no tissue been removed. Although the pack was removed only six hours later and hydrocortisone suspension applied, a contact dermatitis resulted on the neck below the ear, as well as in the ear canal. Several days of treatment were required for relief.

Actually, patients with localized inflammation recover more quickly when tissue is removed for biopsy, as evidenced by two brief case reports:

Case No. E58-36. A white male auto mechanic, aged 46, complained of a painful left ear. Clinically he had acute diffuse external otitis with preauricular and postauricular swelling. A very acute inflammation of the epithelium superimposed on a chronic infection of the subepithelial tissue was found when histologic examination was made. Although penicillin injections were given daily for three days, the patient returned five days later with acute inflammation of the right (other) ear, stating that he had obtained so much relief following incision and drainage of the first ear that he would like the second ear incised and drained.

Case No. E58-37. A 21 year old Negro woman came in suffering with pain in both ears. The left ear had become sore three days previously; the right, two days previously. Both ears were painful when first seen, the left being more painful. Examination of the right ear canal revealed moderate swelling of the skin with a furuncle draining above. The skin of the left ear canal was much more swollen, with apparent localization on the posterior wall; tissue for biopsy was taken from this area. Both ears were packed with cotton moistened with Cortisporin, and penicillin was administered parenterally for three days. Cortisporin was prescribed for home use, as well as adequate sedation. The left ear, which was incised and drained by removal of the tissue for biopsy, was greatly improved in two days and healed in four. In the right ear, where the inflammation presumably had localized, with rupture of a furuncle and drainage of frank pus, six days were required for recovery.

Our search of the literature has revealed only two reports of biopsies by other investigators. Senturia[3] did not discuss the safety of the procedure, but Perry[2a] stated, "Biopsy of the skin of the human ear canal is a safe procedure. This statement is based on the experience of over 200 biopsies without a single untoward reaction." We, too, consider that this is a safe procedure when properly performed and when adequate antibiotics (or chemotherapy) and other indicated supportive measures are prescribed.

ACUTE EXTERNAL OTITIS

We have previously reported 20 acute cases, 12 of them complicated with furunculosis. Our present report includes an additional 18 acute cases, chosen to illustrate different types and phases of acute external otitis. Cases discussed herein have not previously been reported.

*Hemorrhagic Bullous External Otitis*

An unexpected phase of our investigation gave us the opportunity to study three cases of hemorrhagic bullous external otitis. Bullous myringitis is not rare; it often involves the epithelium covering the osseous canal wall. Three of our cases were definitely hemorrhagic bullous external otitis, involving only the skin of the osseous canal just external to the tympanic membrane.

The first patient (E58-10) was a 16 year old white girl who had had some hemorrhage from the right external ear canal earlier that morning. Examination of the canal revealed that it was filled with blood clots. When the clots were removed, the tympanic membrane was found to be intact, and three small hemorrhagic bullae were noted on the posterior canal wall just lateral to the tympanic membrane. The superficial portions of the bullae were removed with biting forceps. A complete blood count was characterized by a slightly increased white cell count (10,400) and slightly increased band forms (8 per cent).

The second patient was a 21 year old Negro man (E58-32) whose left ear had become slightly painful four days previously. On the night before we saw him it had hurt enough that he went to a hospital outpatient clinic, where "drops" were used. The right ear had become sore two days previously, and he had noted some bloody discharge from it on awakening that morning. Examination of the right external ear canal revealed a hemorrhagic bulla on the posterior-inferior canal wall just lateral to the tympanic membrane. The superficial portion of the bulla was removed with forceps (fig. 1). Examination of the left (other) external ear canal revealed that it was filled with moist exudate. Smears and cultures were taken from it. After the left canal had been cleaned, the epithelium of the tympanic membrane and the adjacent canal walls were found to be quite congested and denuded, with a serous discharge. We consider this a later stage of bullous myringitis and external otitis, after rupture of the bullae. The complete blood count was normal and cultures did not reveal pathogenic bacteria or fungi.

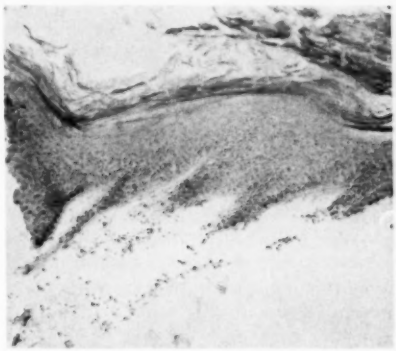

FIG. 1—Case E58-32. Hemorrhagic bullous external otitis. The superficial (epithelial) portion of a bleb was obtained for this biopsy. The line of cleavage is immediately below the basal layer of epithelium and a few inflammatory cells are present below the line of cleavage. There is hyperkeratosis and spongiosis of the epithelium over the bleb. (Hematoxylin and eosin, ×150)

The third patient was a 17 year old white boy (E58-56) who had been swimming and diving two days previously. Pain was first noted the following evening and was only moderately severe. Examination of the right external canal revealed a hemorrhagic bulla just lateral to the tympanic membrane,

involving the inferior posterior osseous canal wall. In this case it was possible to remove tissue for biopsy through the bulla, obtaining deep tissue as well as superficial.

Very careful biopsies in the first two cases showed only hyperkeratotic epithelium with slight spongiosis and a few mixed inflammatory cells on the "cleavage" side. In the third biopsy, only slight inflammation of the epithelium was noted but all infiltrating cells were neutrophils; moderate inflammation of the subepithelial tissues was present with approximately 60 per cent neutrophilic infiltration. Within the bulla were found blood clots, and mixed inflammatory cells were seen in the connective tissue under the bulla. The tissue for these biopsies was taken from the osseous canal walls and no skin appendages were seen. It may be worthy of comment that all three patients were young. No epidermal degeneration or inclusion bodies were present. Hemorrhagic bullous external otitis is generally thought to be of viral origin but there were no histopathologic findings in these three biopsies to substantiate this opinion.

*Acute Eczematoid Dermatitis*

Our series includes two cases of acute eczematoid dermatitis. One involved a 15 year old Negro boy (S58-1134) who had had attacks of earache on the right side five months and three month previously, and itching, swelling and discharge for the previous five days. The skin of the canal was swollen, with an excoriated area at the meatus extending down into the concha, covered with seropurulent discharge.

The other patient was a 60 year old white woman (E58-28) who reported that her ears had itched, off and on, for twenty years; the left ear had been itching, sore and discharging for the previous two weeks, with no treatment other than alcohol drops at intervals. Examination revealed some generalized swelling of the canal epidermis with an excoriated area extending from the meatus into the concha, exuding a seropurulent discharge. Smears revealed 1 plus neutrophils with an occasional eosinophil, and Gram positive cocci, diplococci and tetrads, mostly intracellular. A culture for fungi was negative.

The white blood counts were 5,150 and 7,200, with 5 per cent and 3 per cent eosinophils. The histopathologic findings in these two cases resembled those reported by Sophian and Senturia[4] more than any of our cases. In the first case early necrosis with angiitis was noted, with a probable thrombus in one area and a concentration of eosinophils (10 to 20 per cent as compared to 5 to 10 per cent in other areas). The histopathologic picture suggested the probability of a ruptured furuncle, or furuncles, destroying the overlying epithelium, and the possibility that pyoderma may be a more correct diagnosis (fig. 2). In the

FIG. 2—Case E58-28. Acute eczematoid dermatitis. There is marked superficial necrosis in the skin, with ulceration of the surface. The inflammatory infiltrate is predominately of polymorphonuclear cell type. (Hematoxylin and eosin, ×60)

second case, superficial necrosis with ulceration and some angiitis were noted, with heavy infiltration (90 to 95 per cent) of polymorphonuclears in epithelial and subepithelial tissues, 5 to 10 per cent of which were eosinophils. Slight hyperkeratosis and parakeratosis, marked spongiosis and moderate hyperplasia were noted. In the first case 4 plus sebaceous glands and 4 plus apocrine glands were seen; in the second case no sebaceous glands but 4 plus apocrine glands were present.

### *Acute External Otitis Secondary to Purulent Otitis Media*

We had one case secondary to a discharging otitis media. The patient was a 51 year old Negro woman (E58-18) who had had a discharge from her left ear for five months, with itching, soreness and some dull pain. The auricle was slightly tender to manipulation and the canal was filled with purulent exudate. Smears for cytology revealed 3 plus neutrophils and 2 plus eosinophils; mixed Gram positive and Gram negative bacteria were present in smears and cultures, but no fungi. After cleansing the canal, the epidermis was found to be slightly swollen; there was a large central perforation of the tympanic membrane with purulent middle ear discharge. Histopathologic examination of the tissue revealed some fibrosis of the dermis, and only slight chronic inflammation of the epithelial and subepithelial tissues. There were comparatively few infiltrating cells, but the interesting finding was a focal concentration of eosinophils in one small area. We consider this an intermediate stage in the development of acute eczematoid dermatitis described above.

### *Acute Infection Superimposed on Allergic Dermatitis*

One of our acute cases was so interesting that biopsies were made of both ears of the patient (E58-2 and 6). The patient was a 20 year old Negro woman who had had four severe attacks of right external otitis during the previous two years, with the ear itching between attacks. The right ear again had become irritated five days prior to her first visit, with "dripping" discharge the following day and steadily increasing pain. She had taken "pain pills," and had used "ear drops" (prescriptions unknown to us), hydrogen peroxide and a hot water bottle. She complained that the right ear was swollen, itching, and running; on the morning of her visit the left ear had started itching. The skin of the right canal was acutely swollen and moist, with fissures and a profuse serous discharge —the clinical picture that has been called "weeping eczema."

Culture of the discharge revealed a pure growth of *Pseudomonas aeruginosa*. The biopsy revealed moderate epithelial inflammation with moderate hyperplasia and spongiosis, and more subepithelial inflammation; 95 per cent polymorphonuclear infiltration of the epithelium, of which perhaps 5 per cent were eosinophils; but only 25 per cent polymorphonuclear infiltration of the subepithelial tissue, of which 10 to 15 per cent were eosinophils. The eosinophils were prominent around the hair follicles. There was very little soreness on manipulation of the left auricle but the canal epidermis appeared dry, slightly thickened and quite scaly.

The skin was carefully and thoroughly cleansed with tincture of Zephiran. A rather wide strip of tissue was taken from the anterior inferior quadrant for biopsy, and then split lengthwise. One half was placed in 10 per cent formalin for histopathologic study; the other was placed in beef heart infusion bouillon, later triturated and cultured aerobically and anaerobically. A mixed culture of beta hemolytic *Staphylococcus aureus*

and *Pseudomonas aeruginosa* was reported. As expected, the biopsy did not show any epithelial inflammation, but there was moderate inflammation of the subepithelial tissues, with 5 to 10 per cent polymorphonuclear infiltration, of which 3 to 4 per cent were eosinophils. In five separate differential white counts, the blood eosinophilia ranged from 5 to 10 per cent, averaging 7 per cent. We think the history of recurrence, the clinical picture, the blood eosinophilia, and the histopathologic findings of spongiosis and eosinophilic infiltration, particularly around the hair follicles, justify us in making the diagnosis of acute infection superimposed on an allergic dermatitis, probably due to bacterial allergy.

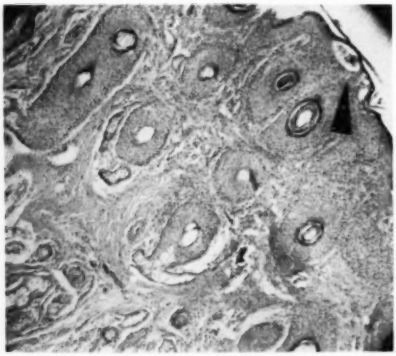

FIG. 3—Case E58-25. *Pseudomonas aeruginosa* infection. Mild epithelial inflammation with moderate inflammation of subepithelial tissues. Small vesicle (arrow) in superficial epithelium differs from vesiculation found with furuncles in that there is no neutrophilic infiltration or accompanying spongiosis. (Hematoxylin and eosin, ×60)

### *Pseudomonas Aeruginosa Infection*

Cultures from two of our acute cases revealed pure *Pseudomonas aeruginosa* infection. Case 58-25 involved a 24 year old white insurance salesman, with no pertinent information in his past history, who complained that two days prior to his first visit his ear felt "stopped up." It began discharging a few hours later, but had not felt sore until the morning of his first visit. There was very little tenderness on manipulation and the epidermis appeared only slightly swollen, with a small amount of purulent discharge. Smears and cultures revealed pure *Pseudomonas aeruginosa* infection. Only slight inflammation of the epithelium and moderate inflammation of the subepithelial tissues were present. The infiltrating cells in the epithelium were approximately 50 per cent neutrophils, while in the subepithelial tissues only 30 per cent neutrophils were present; there were no eosinophils. There were no bacteria in the Gram stained sections (fig. 3).

In Case E58-4, a 43 year old white farmer reported that he had had a "fungus infection" while in the South Pacific in 1944, with recurrent attacks since, usually during the winter. He complained of increasing pain for five days prior to his first visit; it was quite severe when he was first seen. The skin of the canal appeared dry and scaly with acute localized swelling superiorly, and very little discharge (probably due to his having used saturated solution of boric acid in spirits of vini rectified). Cultures were negative for fungi, but there was a pure growth of *Pseudomonas aeruginosa*. There was very slight epithelial inflammation with 95 per cent neutrophilic infiltration and moderate subepithelial inflammation, with only 15 to 20 per cent neutrophils.

### *Mixed Bacterial Infection*

Two of our patients had mixed bacterial infections. The clinical course of Case E58-37 is reported above. Cultures revealed *Pseudomonas aeruginosa* and mannitol-positive *Staphylococcus aureus* in the right ear (with a draining furuncle). Although the left ear had been

involved longer and was more painful, biopsy revealed no epithelial inflammation, but marked subepithelial inflammation with 50 per cent neutrophils.

In Case E58-8, the patient, a 64 year old white salesman, probably suffered more severe pain than any of the other patients. He had never had any ear trouble until he noted progressive swelling and discomfort in his right ear two days prior to his first visit. He had received a penicillin injection elsewhere the previous evening, but no local ear treatment. Mixed Gram positive and Gram negative organisms were present in smears, but cultures grew only mixed Gram negative organisms, *Pseudonomas aeruginosa* and Gram negative cocci. Culture for fungi was negative. Biopsy revealed moderate inflammation of the epithelium and subepithelial tissues, with approximately 95 per cent neutrophilic infiltration of the epithelium but only about 35 per cent polymorphonuclear infiltration of the subepithelial tissues, of which approximately 1 per cent were eosinophils. The clinical course of this case suggested a superimposed acute contact dermatitis, but we did not feel justified in definitely making that diagnosis, although the biopsy did show marked spongiosis of the epidermis.

### *Mixed Fungal and Bacterial Infection with Furuncle*

One of our patients had an acute fungus infection, with mixed Gram positive and Gram negative bacterial infection and furuncle formation. Case E58-30 involved a 43 year old white farmer who complained that his right ear felt "stopped up" and sore, with a history of three to four weeks involvement following swimming and showers. He had used home remedies, but the ear became very sore three days before his first visit. It started draining the day prior to his visit with a resultant decrease of pain. Examination revealed that the canal was filled with moist exudate and discharge. Smears and cultures were taken. After cleansing the canal, a draining furuncle was noted just within the aditus in the superior quadrant; a biopsy was taken.

The cultures grew mixed Gram positive and Gram negative bacteria and fungi. There was marked inflammation of all tissues with 95 to 100 per cent neutrophilic infiltration into the epithelium throughout the specimen, but there was an entirely different picture in the subepithelial tissues around the furuncle to that noted away from it; around the furuncle the infiltrating cells were approximately 75 per cent polymorphonuclears with perhaps 1 per cent eosinophils, while in other areas there were noted only approximately 20 per cent polymorphonuclears, of which approximately 3 to 5 per cent were eosinophils.

### *Acute Inflammation Superimposed on Chronic Inflammation*

Case E58-7, involving a 53 year old white farmer, illustrates a mildly acute inflammation superimposed on chronically inflamed tissues. This patient reported an attack of bilateral acute external otitis six years prior to his first visit; four months before this visit he had had a mild, moist external otitis; a culture for fungi had been negative. He came in complaining of itching and tenderness of the left ear of seven days' duration; it had been painful for the last three days. The skin of the canal was swollen and the ear was painful on manipulation. The biopsy revealed hyperplasia of the epidermis with some fibrosis of the subepithelial tissues; moderate inflammation of the subepithelial tissues with approximately 95 per cent mononuclear infiltration; slight to moderate inflammation of the epithelium with approximately 95 per cent neutrophilic infiltration.

Case E58-34 was similar in that the patient, a 34 year old white tower painter, gave a history of recurrent external otitis of the right ear over a four year period, usually after swimming. It differs in that the biopsy was made at a later stage, after twenty-four hours' treatment. When first seen the tissues were quite swollen, involving the preauricular and postauricular areas and occluding the canal. After sedation, antibiotics and Domeboro packs for twenty-four hours, most of the edema subsided and furuncle formation was noted. This area was incised and drained by removing tissue for a trough biopsy. The specimen included the edge of the furuncle, where there was only slight inflammation with 100 per cent neutrophilic infiltration of the epithelium but marked inflammation of the subepithelial tissues with approximately 75 per cent neutrophilic infiltration and no eosinophils.

Biopsies E58-35 and 36 of the two ears of the same patient (mentioned above) demonstrate the different stages of development of the inflammatory process. Previous treatment of the first ear had been effective to the extent that the acute inflammation was subsiding, as evidenced by only slight inflammation of the subepithelial tissues. This inflammation was classed as moderate, with only 40 per cent neutrophilic infiltration, mononuclears predominating. When the patient later returned with acute inflammation of the second ear, without previous treatment, the inflammation of both epithelial tissues and subepithelial tissues was marked, with 100 per cent neutrophilic infiltration into the epithelium, and 70 to 75 per cent polymorphonuclear infiltration into the subepithelial tissues, with eosinophils accounting for 3 to 5 per cent.

*Furuncle Involving Osseous Canal Wall*

While furuncles are usually found in the cartilaginous canal wall, case E58-38 illustrates the fact that furuncles can involve the osseous canal wall. A 33 year old white toolmaker reported that he had had "boils in ears" following swimming when he was a child, but that he had had no trouble for the past twenty years. Two days prior to his first visit he had gone swimming and had done a lot of under-water swimming. Pain was first noted the following afternoon, increasing in severity during the night; it was quite severe when he came in the next morning. There was little tenderness on manipulation. Examination revealed only slight swelling of the skin of the cartilaginous canal but definite localized swelling of the roof of the canal just external to the tympanic membrane.

The tissue for biopsy was taken through the center of the swollen area, extending laterally. Clinically, this tissue included the skin of both cartilaginous and osseous canal wall: this was confirmed by the biopsy. There was no inflammation of the epithelium and only moderate inflammation of the subepithelial tissues (about 98 per cent mononuclear infiltration) in the areas not involved in the furuncle. In the area of the furuncle, approximately 95 per cent of the infiltrating cells were neutrophils. We were particularly interested in comparing the frequency of skin appendages in these areas. We found 4 plus hair follicles, 4 plus sebaceous glands and no apocrine glands in the skin of the cartilaginous canal wall; there were very few hair follicles, no sebaceous glands, but 4 plus apocrine glands in the osseous canal skin.

COMMENT ON ACUTE EXTERNAL OTITIS

Our previous study[1] had inclined us to believe that only Gram positive bacteria caused deep inflammation in the skin of the external ear canal. Our present study provides evidence to the con-

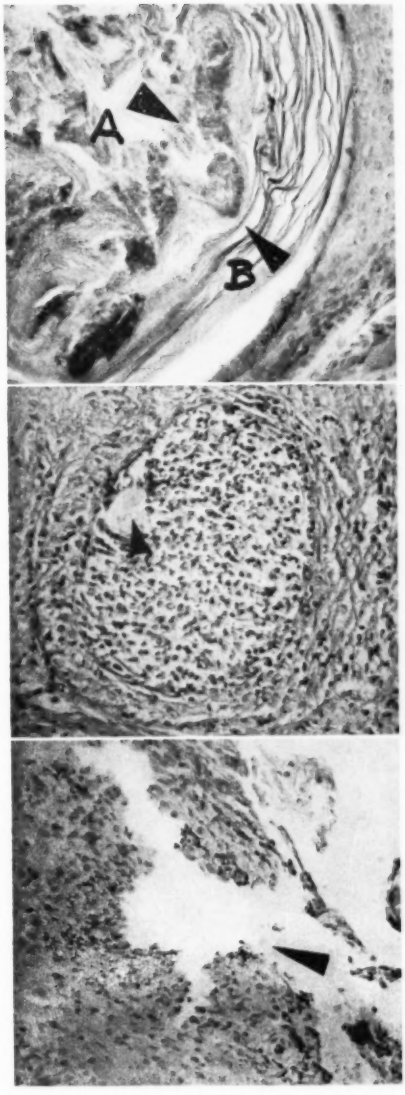


FIG. 4—Furuncle formation. (Top) Case E58-11. Clumps of Gram positive micrococci (B) are present within the thickened keratin layer inside a hair follicle. These clumps of bacteria surround hair shafts (A). (Hematoxylin and eosin, ×300) (Center) Case E57-136. Polymorphonuclear leukocytes are within this hair follicle. The arrow indicates a hair shaft within the inflammatory exudate. (Hematoxylin and eosin, ×300) (Bottom) Case E56-185. A hair shaft (arrow) is part of the debris within this ruptured furuncle. In serial and semiserial sections of this furuncle other hair shafts were seen. (Hematoxylin and eosin, ×60)

trary, even though we have been unable to find any Gram negative bacteria in the tissues. In biopsies of the two cases with *Pseudomonas aeruginosa* infection there was moderate inflammation of the subepithelial tissues, but only slight epithelial inflammation. We are of the opinion that the severe deep inflammations, with or without furunculosis, are due to Gram positive bacteria.

We also wish to comment on furuncle formation. We have been asked whether our findings have justified our diagnoses of furunculosis. We believe that they do. Further, we believe our studies will illustrate the various stages of furuncle formation and rupture. Figure 4 (top) (from a chronic case, E58-11, that will be discussed later) reveals Gram positive micrococci in a hair follicle. Figure 4 (center) from case E57-136 (reported in our previous series) shows neutrophilic infiltration in a hair follicle; we think this represents an early stage in the development of a furuncle. Figure 4 (bottom) from case E56-185 (also in our previous series) illustrates a furuncle involving several hair follicles, rupturing externally. The photomicrograph shows a fragment of hair shaft in the rupturing furuncle, and numerous other fragments were seen in serial and semiserial sections of the same furuncle.

## CHRONIC EXTERNAL OTITIS

We are particularly interested in our remaining fourteen cases, all of which can be classified as chronic external otitis, with only two showing mild acute infection superimposed. It is our hope that our studies in this field will contribute to an understanding of the pathogenesis of acute external otitis, as well

as chronic external otitis, so that correct diagnoses can be made more quickly, effective treatment instituted and, perhaps equally important, prophylactic measures prescribed to prevent acute episodes.

One of these patients (E58-9) was 20 years old, but the others ranged from 37 to 66 years of age, with six in the fifth decade. Eleven were white, and nine were women. All complained primarily of itching ears, from one to twenty years' duration. None were seen following swimming and most of them avoided getting water in the ear canals. All admitted trauma (scratching) to greater or lesser degree. All had been treated previously. Two gave a history of allergy, four had previously had attacks of seborrheic dermatitis on the face or neck, and nine had dandruff.

We considered the hypothesis that all of these cases could be classified as neurogenic, seborrheic, atopic or contact dermatitis. Unfortunately, the clinical picture and the histopathologic features in the mild cases are similar, not diagnostic, and we were unable to make specific diagnoses in all cases. There was adequate evidence to establish the diagnoses of neurogenic dermatitis in two cases, seborrheic dermatitis in four, atopic dermatitis in one and contact dermatitis in one, but our findings justified only the diagnosis of mild chronic nonspecific dermatitis in the remaining six cases.

*Neurogenic Dermatitis*

The diagnoses of the two cases of neurogenic dermatitis were made with considerable difficulty. One patient was a 56 year old white manufacturing foreman (E58-23) who complained of a recurrent itching lesion in the floor of the left canal at the vestibule over a 40 year period, each episode lasting two to five days. This lesion was observed on several occasions; it was approximately 8 to 10 mm. long and 4 to 5 mm. wide, slightly more congested than the surrounding skin and slightly swollen. Symptoms were alleviated with hydrocortisone cream. The possibility of a fixed allergic lesion was considered, partly because of a blood eosinophilia of 7 per cent, but diagnostic skin testing was refused and trial diets were inconclusive. Histopathologic examination revealed an elevation of the epithelium over an area of marked pseudoepitheliomatous hyperplasia, some spongiosis, and marked hyperplasia of the epidermis. Only slight inflammation of the epithelium was present but the few infiltrating cells present were all neutrophils. There was moderately severe inflammation of the subepithelial tissues, with approximately 80 per cent mononuclear infiltration and less than 1 per cent eosinophils. This cannot be considered a diagnostic picture, but these findings, together with consultation with a psychiatrist and a recurrence after getting very angry, made the diagnosis (fig. 5).

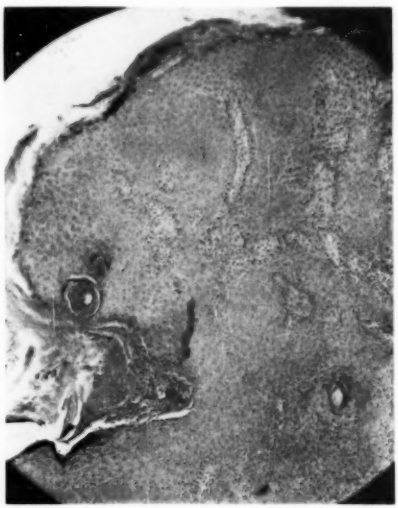

FIG. 5—Case E58-23. Neurogenic dermatitis. Marked pseudoepitheliomatous hyperplasia and hyperkeratosis characterize this biopsy. There is a sharp elevation of the lesion above the level of the surrounding skin. A moderately severe inflammatory reaction, predominately mononuclear, is present in the subepithelial tissues. (Hematoxylin and eosin, ×60)

The other patient was a 42 year old white housewife (E58-29) who complained of recurrent attacks of itching of both ears over a ten to fifteen year period, admitted scratching her ears with "anything handy," with occasional soreness afterwards, but never any severe pain. On examination the skin of both canals appeared a little thickened and dry, with a few small scales of desquamating epithelium. Of particular interest, there was noted in both ears a small area, approximately 4 mm. in diameter, at the vestibule in each posterior-superior quadrant, where the skin was slightly congested, appeared smoother, and was surrounded by a ring of scales of epithelium, as though the superficial areas of the epidermis had been rubbed off. The blood eosinophilia was only 2 per cent. The histopathologic changes were similar to those seen in the previous case but less marked, there being no epithelial inflammation, with only 10 per cent neutrophils and no eosinophils in the subepithelial tissue, no spongiosis and only slight hyperplasia of the epidermis. These findings and the consideration of the patient as a neurogenic individual made the diagnosis. As a dermatologist friend says, "Where does the neurogenic patient scratch? If the ear, you have neurogenic dermatitis of the ear."

*Seborrheic Dermatitis*

We were able to make the diagnosis of seborrheic dermatitis of the external auditory canal in four of our cases (E57-157 and 159, E58-3 and 5). Here it seems appropriate to quote Perry's statement,[2b] "This is a diagnosis made too frequently by the dermatologist, and not often enough by the otologist." All four patients complained only of itching and some soreness at intervals over a period of ten or more years. While these symptoms were present at the time of examination, none of the patients complained of any great discomfort, and one was showing improvement following a penicillin injection given two days previously. All were 40 years old or older, all were white, two males and two females. The diagnosis was made on the basis of the clinical appearance of dry, scaly, slightly thickened, swollen skin surface with a history of seborrheic dermatitis and, in two cases, lesions on the face. Dandruff was present in all. (While we have seen the typical waxy scales in external canals, they were not present in these patients.) The white counts were low, with one exception, and this one was obviously not due to aural infection. In three cases there were very few inflammatory cells in the epithelial and subepithelial tissues, these being at least 98 per cent mononuclears, but there was some hyperplasia of the epidermis (probably due to scratching the ears over a period of years) (fig. 6).

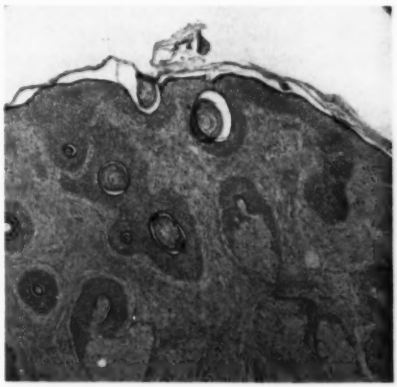

FIG. 6—Case E58-5. Seborrheic dermatitis. Surface epithelium appears thin compared to acute lesions. Note hyperkeratosis and subepithelial fibrosis. Very few inflammatory cells present. (Hematoxylin and eosin, ×60)

The fourth case was the one previously treated with penicillin and the patient apparently was recovering from a superimposed infection. The biopsy in this

case showed moderate inflammation of both epithelial and subepithelial tissues, and the histopathologic picture suggested a healing process.

*Atopic Dermatitis*

The one case we diagnosed as chronic atopic dermatitis was that of a 37 year old Negro woman (E58-11) who sought treatment for allergic rhinitis, but also complained of "itching and breaking-out of the right ear, feeling like a fever blister." When questioned, she stated that she had had a cold every time the ear was involved, but that the ear was not involved every time she had a cold. She had a history of allergy, and said she could not wear jewelry because her skin would "break out"; however, contact patch tests on her back with gold, silver, copper, potassium chromate, cobalt and nickel were all negative after 48 hours. The skin of the canal appeared thickened, slightly scaly and desquamating, but this was the one patient who had a fairly large amount of cerumen in the canal. Her blood eosinophilia was only 1 per cent but 1 plus eosinophils were found in her nasal secretion. In the other ear, a few small dry scales were noted, along with some cerumen. The tissue for biopsy was taken from the anterior-inferior quadrant, extending into the concha. Biopsy showed 4 plus sebaceous glands and 2 plus apocrine glands. There was no epithelial inflammation and only moderate diffuse subepithelial inflammation; approximately 99 per cent of the infiltrating cells were mononuclears, and there were no eosinophils. While there was only slight hyperplasia and hyperkeratosis of the epidermis, there was a greater degree of follicular hyperkeratosis. Large clumps of Gram positive micrococci were found in two areas of follicular hyperkeratosis. We believe that the history of allergy and of head colds with the appearance of aural symptoms, the co-existence of allergic rhinitis, and presence of large numbers of micrococci in areas of follicular hyperkeratosis justify the diagnosis of mild bacterial atopic dermatitis.

*Contact Dermatitis*

In case E58-9, a 20 year old Negro woman reported that she had had itching in both ears for at least six years, frequently intense, and soreness only following scratching. She also complained of itching in and around the vagina just before the menses. She had dandruff and a history of a skin eruption on the face that suggested seborrheic dermatitis. At the time of examination she had a contact dermatitis of the lobules of both ears caused by earrings. The skin of the canals appeared slightly thickened and dry, with a few fine scales and a good many hair follicles, but no cerumen.

Histopathologic examination revealed no epithelial inflammation but some inflammation of the subepithelial tissues, with almost 100 per cent mononuclear infiltration. There was moderate hyperkeratosis, slight parakeratosis and moderate hyperplasia, with definite melanin pigment deposits in the upper dermis, indicating a chronic irritation. These changes may be found in all mild chronic dermatoses and are not characteristic of any specific dermatitis. We realize that it is difficult to make a differential diagnosis between seborrheic and contact dermatitis in this case, but we made a diagnosis of mild chronic contact dermatitis because the symptoms that had caused her to come in for examination related to an active contact dermatitis of the lobules.

*Mild Chronic Nonspecific Dermatitis*

None of the remaining six patients complained of pain; they complained only of the discomfort of itching, worse at times, of one to twenty years' duration. Their ages ranged from 45 to 66

years; four were women and five were white. The ears were not tender on manipulation. In all cases the skin appeared dry and thickened, with a few small, dry scales of desquamating epithelium. One patient's ear canals were filled with dry keratinized scales. We considered the influence of the number of hair follicles present, but only found that hirsute individuals had more hair follicles in their external ear canals. The absence of cerumen may be a factor; none of these patients had any cerumen in their canals. This naturally led to consideration of the number of apocrine and sebaceous glands in the tissue removed for biopsies. This is influenced by the site of tissue removal, and in the two biopsies that did not show any glands, the tissue was taken from the posterior wall. (In four other biopsies in this series the tissue was taken from the posterior wall; two had no glands, one had no sebaceous glands but 3 plus apocrine glands, and the other had 4 plus sebaceous glands and no apocrine glands.) Although there were variations in the number of glands present, no pattern could be established. Slight to moderate hyperkeratosis and hyperplasia were found in all (fig. 7).

Only one patient, the 49 year old housewife whose canals were filled with keratinized scales, had any spongiosis of the epidermis. This latter case showed 70 per cent neutrophilic infiltration in the epithelium, and one other (that of a 57 year old Negro man) showed 50 per cent neutrophilic infiltration. A moderate number of cells were present in the first case, few in the second, and too few to consider in the remaining four cases. The infiltrating cells in the subepithelial tissues varied from 80 to 100 per cent

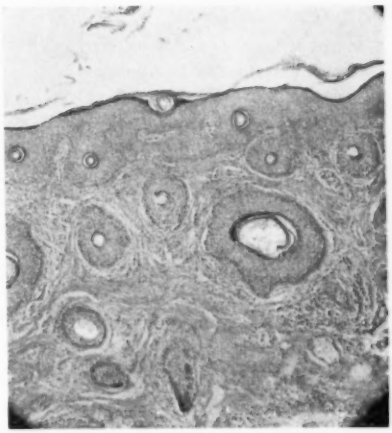

FIG. 7—Case E58-26. Mild chronic dermatitis. There is only slight superficial hyperkeratosis but moderate follicular hyperkeratosis. There is a moderate degree of subepithelial infiltration, approximately 85 per cent mononuclear. (Hematoxylin and eosin, ×60)

mononuclears. In only one case (that of the 57 year old Negro man mentioned above) were any eosinophils present, and in that case, only 1 to 2 per cent. The highest white blood count was 8,400 per cubic millimeters. The only characteristics of these six cases were the symptom of itching and the histopathologic findings of slight to moderate subepithelial inflammation, with 85 to 100 per cent mononuclear infiltration, and slight to moderate hyperkeratosis and hyperplasia. These findings justify only the diagnosis of mild chronic nonspecific dermatitis.

## SUMMARY

As a continuation of our studies of the pathogenesis of dermatoses of the external auditory canal, we are reporting an additional 32 biopsies from thirty patients, correlating histories, clinical examination and indicated laboratory procedures with histopathologic studies of biopsies in each case. This series includes the following types of cases:

*Acute External Otitis*

Hemorrhagic bullous external otitis
Acute eczematoid dermatitis
Secondary to purulent otitis media
Superimposed on allergic dermatitis
Due to *Pseudomonas aeruginosa* infection
Due to mixed bacterial infection
Due to mixed fungal and bacterial infection with furuncle
Acute inflammation superimposed on chronic inflammation
Furuncle involving osseous canal wall

*Chronic External Otitis*

Neurogenic dermatitis
Seborrheic dermatitis
Atopic dermatitis
Contact dermatitis
Mild chronic nonspecific dermatitis

This wide variety of diagnoses emphasizes the truth of the statement that external otitis is really a generic term, including many clinically different entities, and that accurate diagnoses should be more specific.

These studies have been made primarily from the clinician's viewpoint with the belief that if we understand the pathogenesis of acute external otitis, we shall be able to make correct diagnoses more quickly, and shall be able to give quicker and greater relief to the suffering patient; perhaps equally important, we shall be able to prescribe prophylactic treatment for the patient with chronic external otitis and prevent acute episodes.

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## DISCUSSION

JAMES W. MCLAURIN, M.D., Baton Rouge, La.: External otitis is a disease which has given me trouble for a great many years, a situation in which many otolaryngologists have also found themselves. I did not begin to emerge from my difficulties until I realized, and put into practice, what Dr. Jones and Dr. Norman have emphasized: Otitis externa is a generic term, a sort of umbrella, which covers a number of different clinical entities, and these entities must be diagnosed specifically if treatment is to be satisfactory. Some cases will always give trouble, but I now believe that the otolaryngologist who has trouble with most or all of his cases is bringing it upon himself by writing prescriptions for some one of the widely advertised panaceas after a quick look into the ear canal rather than a complete examination of his patient.

I think it well to emphasize this point. The authors of this paper have done an excellent piece of investigative work, and I congratulate them on their contribution to the pathogenesis of otitis externa. I agree with them, incidentally, that when a localized exudate is present, healing is expedited by its evacuation, whether in the course of removing tissue for biopsy or by deliberate incision. I am afraid, however, that the authors have made biopsy seem the answer to the diagnostic problem. I am afraid it is not quite so simple.

The otolaryngologist who takes the time to obtain a complete history of his patient and who carries out a thorough examination, including smears and cultures as necessary, will seldom have to rely upon biopsy for specific diagnosis. In my opinion, biopsy is indicated only in certain persistent or recurrent infections of the aural canal. Lesions in which biopsy is most likely to be of help are contact dermatitis, granulomas, impetigo, keratosis, lupus, psoriasis, and tumors. In most of these, such as in lupus and psoriasis, there are likely to be lesions elsewhere on the body which will lend themselves more readily to biopsy. When fungi are suspected, special staining is necessary. It goes without saying that when a new growth is evident or suspected, biopsy is mandatory.

When biopsy is undertaken, four precautions must be emphasized:

1. It must be interpreted in the light of a thorough otolaryngologic examination and an examination of the skin of the face, scalp, and other areas as well as of the external ear. Also, there must be a search for possible systemic disease, such as diabetes or hepatic disease. All of this information is necessary for the correct interpretation of skin biopsies, which are diagnostic in only a relatively small number of instances. More often, the histopathologic picture is either only suggestive or not at all distinctive.

2. The tissue for biopsy must be taken under as sterile conditions as possible.

3. The specimen should be divided into two portions, one of which should be used for tissue culture.

4. The examination must be made by a pathologist who is thoroughly familiar with the histopathology of the skin, which is a highly specialized area.

I want to thank the Academy for allowing me to participate in this discussion and to say again that the investigative work of Dr. Jones and his associates is contributing materially to our knowledge and treatment of this very troublesome disease.

BEN H. SENTURIA, M.D., St. Louis: I should like to congratulate Drs. Jones and Norman on their most important contribution to our understanding of the dermatoses which involve the skin of the external ear.

Our research group is in general agreement with most of the findings presented here, but as the authors indicated, there are some areas in which we are at variance.

I shall not take time to enumerate the many important contributions which a careful study of this type makes toward the practical management of external otitis. In general, it may be said that careful studies of the histopathologic changes found in biopsies of the ear canal have forced us to review and revise our therapeutic techniques.

I should like to dwell briefly on several points on which there is need for further discussion and investigation. The first deals with the construction of a classification. Let us examine the classification which M. D. Marcus and I published in 1952. Please note that we have used an etiologic classification. We are of the opinion that, whenever possible, this is desirable, since it offers better diagnostic categorization and thus provides a more specific approach to therapy. Until the time when we have a much better knowledge of the dermatopathologic changes and when we have more adequate information regarding the morphologic characteristics of these dermatoses, I should hope that we might agree on a consistent etiologic classification.

We would prefer to avoid classifying our cases into acute and chronic groups, since any given case, whether it be diffuse external otitis or contact dermatitis, may be acute on one day and chronic the next week. We are all familiar with the patient who shows *chronic* neurodermatitis confined to the external orifice of the ear canal but under some stressing conditions develops *acute* vesiculation, fissuring, weeping and crusting.

It is essential to recognize both in diagnosis and treatment that more than a single etiologic factor may be involved. A patient may first complain of an uncomplicated neurogenic external otitis. If he then misuses or overuses some topical medication he may, depending on his skin sensitivity, develop a contact allergic dermatitis or produce a primary irritation or chemical dermatitis.

Dr. Jones and I have discussed at some length the use of the terms *furuncle* and *abscess*. Let us consider the pathogenesis of these entities. If a subject contaminates his ear in one manner or another with Pseudomonas organisms he may readily produce a diffuse external otitis involving the entire ear canal. If this is uncontrolled, there will develop a deep-seated cellulitis within the dermis which may eventuate in deep focal abscesses which must erode through the epidermis in order to reach the lumen of the ear canal. Although in a broad sense these may be called furuncles, they are, strictly speaking, dermal abscesses independent of hair follicles.

On the other hand, if the patient introduces a coagulase positive Micrococcus aureus into one of the hair follicles, he produces an infection of the pilosebaceous unit with localized perifollicular infiltration. This is a furuncle and is invariably restricted to the outer one third of the meatus.

I have urged the essayists to differentiate clearly the dermal abscess found in acute diffuse external otitis from the furuncular infection which is localized in and around the hair follicle. There is much more involved here than a didactic difference of opinion. Penicillin therapy is curative in the one and contraindicated in the other. Furthermore, uncertain and inadequate therapy in severe diffuse external otitis leaves irreversible sequelae in the ear canal which dooms that ear to inevitable exacerbation whenever there is any period of elevated temperature and humidity.

Let us move to another point of contention. I hesitate to express a dissent regarding anything in the allergic category since we are all aware of Dr. Jones' extensive knowledge of allergic matters. However, those of us who have been concerned with dermatopathology agree that the presence or absence of eosinophils in skin biopsies is not paramount in the diagnosis of allergic dermatoses such as contact or atopic dermatitis.

The most difficult category of external otitis from the standpoint of diagnosis as well as treatment is the neurogenic group. The diagnosis is made by a process of exclusion with full consideration and evaluation of the patient's personality. Thus, it is necessary to rule out seborrheic dermatitis, contact dermatitis, and primary irritation. The key question, which many of us do not take time to ask the patient, is whether there are skin irritations on any other part of the body. Once the presence and distribution of other skin lesions is established, it is easier to make the correct diagnosis.

I believe it is clear from what has been said, that the essayists and our research group differ primarily concerning the framework into which we are to fit our findings. Dr. Jones and Dr. Norman have, with great enthusiasm and energy, enlarged and extended our knowledge of the pathologic changes found in dermatoses of the skin of the ear canal. It is with sincere admiration and appreciation that I congratulate them.

DR. JONES: My discussion will be very brief. I want to thank Dr. Senturia and Dr. McLaurin for their contribution. Naturally, we should disagree. Whenever it gets to the point that we agree on everything, progress stops. Of course, Dr. Senturia and I have already disagreed on his classification; but, while I am not satisfied with his, I still have not been able to work out one with which I am satisfied. Perhaps sometime we will come up with one on which we all agree.

About Gram negative and Gram positive infections: I think we are again in agreement, because one does not get furunculosis from a Gram negative organism. In one case we triturated one half of the tissue removed for biopsy and cultured it. This procedure demonstrated, along with the *Pseudomonas* which prepared the field, the hemolytic *Staphylococcus aureus* which caused the furuncle.

Now, of course, so far as the patient is concerned, the difference between furuncles and abscesses in external otitis is like the difference between "tweedledum" and "tweedledee," and is not important since we really agree on the principles. If we can get something out of this study that will help the patients, we will feel that we have accomplished something.

# OPTICAL AIDS FOR LOW VISUAL ACUITY

GERALD FONDA, M.D.
SHORT HILLS, NEW JERSEY
DANIEL SNYDACKER, M.D.
CHICAGO, ILLINOIS

THE National Society for the Prevention of Blindness has estimated that there are 150,000 persons in the United States whose vision ranges between 3/200 and 20/200 or whose vision is better than 20/200 with a visual field constricted to 20 degrees or less. There is another group of persons with subnormal vision whose vision ranges between 20/200 and 20/60. There is no known estimate of the number of persons in this group. However, a conservative guess would be about 250,000. This adds up to a total of 400,000 persons in the United States whose vision ranges between 3/200 and 20/60.

Every ophthalmologist must see patients afflicted with macular degeneration, albinism, optic atrophy and many other eye diseases; but in many instances he is not aware of his responsibility to the patient with subnormal vision whom he discharges, stating that nothing more can be done, once he has exhausted medical and surgical treatment.

The purpose of this program is to focus the attention of the ophthalmologist upon this group of neglected patients, many of whom can be rehabilitated by a more careful refraction and by the use of strong plus lenses. It has been demonstrated that it is worth one's while to prescribe a lens for 50 per cent of the patients examined for low vision lenses, and of the patients for whom lenses were prescribed, 70 per cent were judged to be successful. On the basis of this information, 140,000 partially sighted people in the United States can be rehabilitated to a variable degree.

No special equipment other than that which every ophthalmologist has in his office is required to prescribe for 80 per cent of the partially sighted patients. In fact, in only 20 per cent of all partially sighted patients is there any special lens needed. The publicity of the new and the unusual has led many ophthalmologists to believe that special equipment and lenses are required to examine the patient whose vision is 20/200.

In most cases the partially sighted patient can read by increasing the size of the retinal image. The young patient can accomplish this by bringing the print close to his eyes and exerting his accommodation. The myopic patient can hold print close to his eyes because of the short far point. Strong plus lenses make it possible to bring the near object close to the eyes when there is inadequate accommodation, thereby enlarging the retinal image.

The size of the retinal image is increased 10 times by bringing the object of regard from 20 inches to 2 inches from the eye (fig. 1). This is exactly

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the mechanism by which 10 times magnification is produced by the myopic eye of —20.00 diopters when reading 2 inches from the eye, or when +20.00 diopters is prescribed to the emmetropic patient with no available accommodation.

Dr. Snydacker, will you classify optical aids?

DR. SNYDACKER: Any device which will enable a patient with defective vision to see a larger image may be classified as an optical aid. A hand magnifier is the simplest device of all and is the most widely used. It may be a simple planoconvex or biconvex lens which varies in power between 4.50 and 14 diopters, or it may be a double convex lens of even higher power mounted on a stand. It is not usual to attempt to correct for chromatic or spherical aberrations in such lenses and so these factors limit their usefulness in higher powers.

Additionally there are physical limitations to a hand held lens, particularly in the higher powers, since a large lens would be so heavy as to be unwieldy. The weight plus the limitation in field as a consequence of the aberrations makes prolonged reading very difficult. The chief use of ordinary magnifying glasses is, therefore, usually limited to spotting specific items such as telephone numbers and stock market quotations.

Projection devices are on the market by which an enlarged image is presented to the patient on either a screen or a ground glass. The magnification of the image varies depending upon the distance of the patient from the screen. Unfortunately such devices are cumbersome, and with them there may not be enough illumination and contrast to make printed material stand out clearly. It follows that these instruments may be of occasional benefit but their use is not widespread.

Pinhole spectacles, either single or multiple, may rarely benefit patients with corneal irregularity.

Contact lenses may be used either to eliminate corneal irregularities or to be the eye piece of a Galilean type telescope. If they are effective in the presence of corneal irregularity, they may be spectacularly so, improving vision from less than 20/200 to 20/20 in some cases. Although the use of a contact lens as the eye piece of a Galilean type spectacle is theoretically possible, it is not practical enough to warrant consideration.

Galilean type telescopes which achieve a magnification up to three times by optical means are chiefly useful in situations in which distant visual acuity must be improved. Optically these telescopes consist of an anterior convex lens separated from a concave eye piece by a distance equal to the difference of their focal distance. In such a system, magnification is achieved at the expense of field

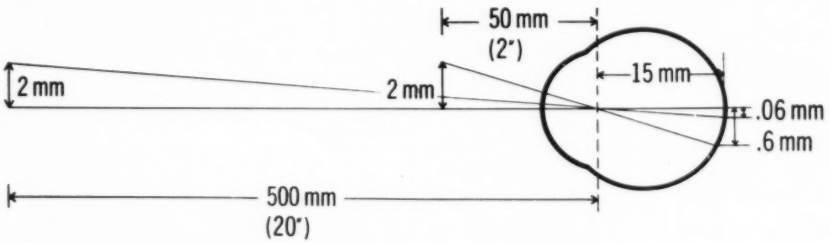


FIG. 1—Method of increasing the size of the retinal image. Print 2 mm. high, 20 inches from the eye, subtends a retinal image of 0.06 mm. The same size print brought up to 2 inches from the eye subtends a retinal image of 0.60 mm., proving that the retinal image is magnified 10 times.

of vision. Hence, the higher the magnification the narrower the field. This fact greatly limits the usefulness of the telescope, although occasionally it can be successfully employed if the patient is seated and viewing a fixed object, such as a movie screen or blackboard. Reading "caps" may be affixed to the front of these telescopes to permit close use.

The effectiveness of many magnifying devices is due to the fact that the patient is enabled to bring objects close enough to his eye so that they seem larger. This is a practical expression of a well-known principle that the nearer an object is to the observer the larger it seems. Thus an object viewed at one-half the distance seems twice as large, at one-third the distance three times as large, and so on. If print viewed at an arbitrarily chosen distance of 25 cm. is considered to be normal, then as this print is brought closer to the eye it will seem larger so that at 12.50 cm. it will appear twice as large (or said to be magnified two times), and at a distance of 8.30 cm. it will appear three times as large (or is said to be magnified three times).

Since the focal distance of a + 4.00 lens is 25 cm., the addition of a + 4.00 to the distance correction of an eye which is incapable of accommodating will enable the patient to see an object at a distance of 25 cm. and this object is seen as being "normal" size. If a + 8.00 is added, the patient will be able to see an object at 12.50 cm. without accommodating, and this object, since it is one-half the distance, will be seen as being twice as large; it will be magnified two times. And so with an add of + 12.00, the object will be seen at 8.30 cm. or one-third the distance and, hence, it will seem three times as large, and will have a magnification of three times.

From these relationships it can be seen that magnification is achieved by bringing the object of regard closer to the eye; the closer it is, the larger is the retinal image. Thus, as Dr. Fonda has pointed out, a youthful patient with active accommodation who can focus on an object at close distance sees that object as magnified without the use of an optical aid.

It is generally true, however, that even the most youthful patients are not going to be able to sustain sufficient accommodation to read at 2 or 3 cm. for prolonged periods, and any person who is presbyopic will certainly need a convex lens. These may be of several forms:

1. Simple high plus adds up to + 20.00 or + 24.00 diopter spheres added to the patient's distance correction may be supplied in the form of a reading glass, either a full or a half glass, or it may be given as a bifocal. High spherical and chromatic aberrations frequently bother the patient very little or not at all. Of 171 patients fitted for reading devices at the Optical Aids Clinic of the Chicago Lighthouse for the Blind, 33, or 20 per cent, were given simple high plus adds and, if we were to test these patients over again, many more plus adds would undoubtedly be given.

2. To reduce these aberrations, various aspheric lenses and combinations of lenses, so-called doublets and triplets, have been used. These lenses are referred to as "best form" lenses and with adds of over + 24.00 appreciably increase the reading field. Of the 171 patients just referred to, 88, or 51 per cent, were fitted with just three variations of the best form lenses at the Optical Aids Clinic, showing that a large percentage of patients can be satisfactorily treated with a relatively limited number of aids.

Dr. Fonda, how do you determine whether or not a patient will adjust to a subnormal vision correction?

DR. FONDA: The motivation and intelligence of the patient are the paramount factors. It is absolutely amazing what an intelligent and highly motivated person whose vision is 3/200 can do with a + 48.00 or + 64.00 diopter lens.

Evaluation of the patient is based upon his history, diagnosis and vision. In addition to age, education and vocation the significant questions are: (1) How long has your vision been poor? (2) For what purpose do you want an optical aid? (3) What type of magnification are you now using? (4) Which is your better eye?

From this information one can quickly predict whether or not it is worth while prescribing any lens. The patient whose vision has been subnormal for a long time is more likely to accept an optical aid than the recently afflicted.

The crucial question is, "For what purpose do you want the lens?" If the patient knows exactly for what purpose he wants an optical aid (e.g., to read his Bible or the obituaries, or at his job), you have a worth while subject. On the other hand, if the patient states that she wants to see better on the street or to play cards or to do her housework, then beware. This lady is not likely to be pleased with your best efforts.

Diagnosis is valuable because some diseases, such as albinism, postoperative aphakia for congenital cataracts and myopic degeneration, have good prognoses. Cases with poor prognoses are those of markedly constricted visual fields, as are seen in retinitis pigmentosa, advanced glaucoma and some types of optic atrophy. Diabetic retinopathy also has a poor prognosis since sudden change is a common occurrence in these patients.

I would like to report the unbelievable case of a 31 year old man whose vision was 2/250 in the right eye and 2/200 in the left eye. The diagnosis was Leber's optic atrophy. The peripheral vision was good. I had prescribed a + 100.00 diopter lens six months previous to a recent interview. I learned that this lens was a failure, as had other lenses been before that. The patient told me that he was an estimator, that he visited people's homes or places of business to quote the cost of moving. He further informed me that he was able to carry out this activity without difficulty, that he experienced very little trouble in finding his way around New York but he did encounter difficulties in strange cities. Then he gave me his business card which indicated that he was general manager of a large moving van company.

I never cease to be amazed at the accomplishments of so many people with so little vision.

Dr. Snydacker, are there any further factors for determining success?

DR. SNYDACKER: The points which you have made are important. Reading with low vision lenses is difficult even under the most favorable circumstances and these patients should not expect to have normal reading function completely restored. It always is a slow process and frequently must be done at a distance of 1 inch or so from the eye. Strong motivation is necessary for the patient to be at all successful.

One factor that has sometimes turned failure into success is the training program carried on at the Lighthouse. One of the secretaries, who herself uses an optical aid, works with each patient to teach him how to use the aid. She determines that the patient will be able to adapt himself before the final prescription is filled. She sometimes spends as much as four or five hours in a number of sessions to make sure the patient knows precisely how to use the low vision lens properly. In a few instances when the patient has seemed unable to

adapt himself during this training period the lenses were not prescribed.

Aged people frequently are not adaptable, so they are less likely to utilize these special lenses.

Some ophthalmologists tend to try low vision aids on many patients with poor vision simply because they do not know what else to do with the patient. While trial of these devices may do no harm, we urge caution about promising too much. It is important to help the patient to a realistic understanding of his visual defect before trying magnifying lenses of any type. In this way there is far greater promise of success.

Dr. Fonda, how many patients over age 75 can benefit by the use of subnormal vision lenses?

DR. FONDA: I am more cautious in my statements about this age group but I think we must recognize that in some instances people over 75 years are more highly motivated than the younger person. This is particularly true of the professional person. I believe that most retired doctors would use a lens daily even though they were limited to the use of one eye and were forced to read one inch from their noses.

Dr. Snydacker, how do you make a psychologic evaluation of a patient with subnormal vision?

DR. SNYDACKER: It usually is not practical to make a complete and formal psychologic evaluation of each patient. Sufficient indication that the patient will accept a low visual acuity lens and make good use of it can be obtained by asking the four questions mentioned a few moments ago and observing the patient's response.

In an attempt to check the accuracy of our relatively superficial psychologic evaluation Charles Myran, psychiatric consultant to the Chicago Lighthouse, interviewed 50 patients who had either received or were candidates to receive low vision lenses. He found that 66 per cent of this group had made a reasonably satisfactory adjustment to the loss of vision and with few exceptions were successful in wearing the aid prescribed. Another 10 per cent whose vision could be improved and who might have been benefited had profound emotional disturbances, in some instances directly related to the visual loss and in others antedating it. As a result this group was psychologically unable to accept the aid. The remaining 24 per cent were not sufficiently benefited from the aid to make prescription of the lens worth while.

Myran also found that patients with higher than average intelligence and with more than average education were more likely to be motivated to wear some type of low vision lens successfully. He also noted that an important factor in success was the patient's psychologic acceptance of his visual handicap. Patients with recent loss of vision who have not yet reconciled themselves to the loss and are still looking for restoration of vision through a miracle or otherwise are not suitable candidates for a low vision aid.

Dr. Fonda, is there any use for a hand magnifier and, if so, what are the indications?

DR. FONDA: Yes, there are four indications for a hand magnifier, even though the same strength lens placed in an eye glass frame increases the field of vision two to three times and leaves both hands free. The advantage of wearing a magnifier in a spectacle is greater in the stronger lenses because the lens cannot be large due to the severe aberrations and the weight. I would list the four indications for a hand magnifier as follows:

1. Some patients have employed an inexpensive hand magnifier for many

years and have done quite well but wish to see the new lenses which have received so much publicity. If the patient has no definite objection to his old hand magnifier, you will do well not to encourage him to purchase an expensive spectacle which necessitates changing his reading habits. Too often this patient given the new and expensive spectacle will return to you, emphatically registering his displeasure and telling you that his old $1 magnifier was much better than the new expensive glasses.

2. It is sometimes difficult to decide whether or not it is worth while prescribing a lens in a spectacle for some patients. They should be advised to purchase an inexpensive hand magnifier and to return within a short period of time for evaluation of their progress. If good progress has been made, then you can prescribe a lens in a spectacle.

3. A few people, senile in many cases, insist upon some assistance. In this situation it seems more kind to suggest an inexpensive magnifier than to state or imply that the condition is hopeless. I do not advocate not telling a person that he is blind and that his vision cannot be restored, but I think the blow should be softened as much as possible.

4. A hand magnifier is sometimes useful as an auxiliary lens for reading small print. For example, a student may do well with a weaker spectacle lens for most of his work and employ a hand magnifier for reading footnotes or fractions (fig. 2).

Dr. Snydacker, in what way does the examination of the partially sighted person differ from a routine eye examination?

DR. SNYDACKER: The basis for the prescription of a low vision lens is the same as for any other prescription, namely, a careful examination and accurate diagnosis, including a painstaking refraction both cycloplegic, when indicated, and noncycloplegic. An integral part of this refraction should be a retinoscopy.

Particular care should be paid to the possibility that the refractive error may be a high myopia or a high astigmatism. In checking the patient's subjective acceptance, one may find that he is not able to discriminate small differences in sphere or cylinder because of low acuity. He should be offered a choice of lenses in 0.50 to 1 diopter or even greater jumps. A $-.50+.50$ or a $-1.00+1.00$ cross cylinder should be used. Because the basis of any ultimate prescription will be a refraction, it is important that this be as accurate as possible. The difference between a vision of 4/200 and 8/200 may not seem much but may be the difference between successful fitting of a low vision aid and failure.

This examination may be done in one's private office. It requires no unusual or special equipment beyond a large measure of patience. Low visual acuity may make it difficult for the subject to decide definitely and quickly, so the refraction may take much longer than a routine one. If sufficient time can be set aside, the private office is an ideal place to carry out the examination. If this is not possible, then the patient can be referred to one of the special clinics with advantage. At the Chicago Lighthouse it is not unusual to spend as much as two or three hours examining and fitting a patient. This is perhaps more time than is actually needed, but we feel that it is one of the reasons for our relatively high percentage of successful cases.

Diagnosis of the disease responsible for poor vision is also important because, as Dr. Fonda intimated, the prognosis for success in wearing a low visual

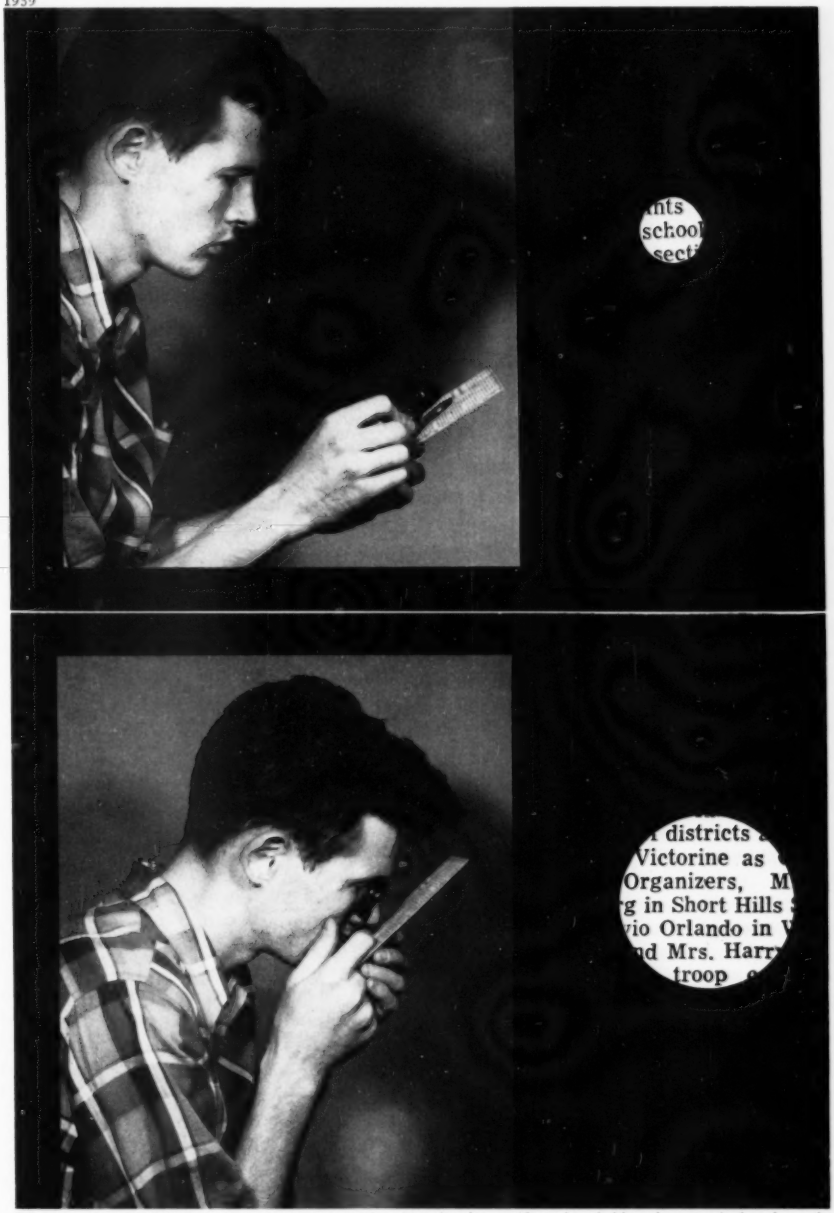

FIG. 2—(Upper) The field of vision seen through a 10× hand magnifier when held at fourteen inches from the eye. (Lower) The same 10× hand magnifier held close to the eye. The field of vision in the latter position is two and one-half times greater. This clearly demonstrates the advantage of wearing a strong plus lens in a spectacle frame.

aid is in considerable measure dependent upon it. In general, patients with marked constriction of the visual field do not respond well. Likewise patients with any active disease are apt to respond poorly since vision may change from day to day. This is particularly true of patients with diabetic retinopathy. On the other hand, patients with quiescent central retinopathy of any type may respond very well, as may patients with congenital visual defects who have nystagmus. Patients with nystagmus often respond surprisingly well, whereas patients with opacities of the media may be helped but more frequently are not.

Dr. Fonda, how do you go about finding what power of reading addition should be used?

DR. FONDA: Most people with subnormal vision request aid for near. Greater improvement can be made more often at close range. I consider an eye examination of the partially sighted person as an extension of a routine eye examination. Once a careful refraction has been done, generally it is a matter of adding more plus for near. Frequently when I encounter a patient whose vision is subnormal due to ocular disease and evaluation indicates that he is a favorable candidate for strong plus lenses, a second appointment is made so that he can be examined for special lenses. In such conditions as aphakia following operation for congenital cataracts and albinism it is not always necessary to make a second appointment to try a + 8.00 or + 16.00 diopter reading addition.

If the patient has binocular vision and his vision is 20/200 or more, he may well be provided with adequate vision with a binocular correction. I like to improve the near vision so that the patient can read equivalent to Jaeger-1 with the weakest reading addition. Binocular corrections can be successfully prescribed in the form of reading glasses, half eye glasses or bifocals with reading additions up to + 10.00 diopters. However, each lens or reading segment must be decentered in 1 mm. for each diopter of reading addition. When it is not practical or possible to decenter in a lens sufficiently, an equivalent prism, base in, can be incorporated in the lens.

When a stronger reading addition than + 10.00 diopters is required, I can only prescribe for one eye. About one third of the patients with subnormal vision can see hand movements or less in one eye so there is only one eye to refract. Depending upon the age, vision, diagnosis and purpose for which the patient requests aid, I try lenses from the trial case usually in steps of + 10.00, + 16.00, + 24.00, + 32.00 and + 40.00 diopters. The higher powers are achieved by a combination of lesser powers in the trial frame. In the rare case when a + 48.00 diopter (12×) or a + 60.00 diopter (15×) is required, a best formed lens must be available to be placed in the trial frame.

Then the patient is shown what he can see, emphasizing that he must practically read with his nose. The limitations of the visual aid are clearly demonstrated and the patient is not encouraged to have glasses made. If the patient states that he cannot hold the paper so close to his eyes, he is told that nothing can be done unless he is willing to read with his nose. It is this type of individual who may not have sufficient motivation to use a low vision lens. But when a patient is fully aware of the limitations of the lens and is willing to cooperate, a prescription is written for him and he is generally directed to an optician interested in fitting glasses for the partially sighted.

Dr. Snydacker, where can low vision aids be obtained?

DR. SNYDACKER: Much of the confusion that relates to the entire subject

of low vision aids is the result of the different types of devices that are distributed under different trade names. A few opticians carry all or most of these different manufacturer's products, although inquiry has disclosed that there is demand for only a few of the items.

As Dr. Fonda has indicated, the most practical and, hence, the most frequently prescribed lens is the simple high plus add. If this is prescribed in the form of a glass for near use only, any optician can grind the lens with equipment already at his disposal. It is true that precise centering instructions should be included in the prescription. If a bifocal is prescribed, there are several commercially available products that the optician can easily procure. Again the instructions in regard to centering the bifocal should be precise, since the power of the lens is such that any small displacement will produce a relatively large amount of prism. Remember that the top edge of the bifocal should be positioned higher than it usually is and should be at least at the top edge of the pupil.

Some communities have centers or clinics where patients can be examined for low vision lenses. In such cases the ophthalmologist need only refer the patient to the center and the aid can be ordered and supplied to him.

It is sometimes advantageous for the patient to go to a special clinic for several reasons:

1. The clinics are usually held in conjunction with special agencies for the blind, and the patient who can go to such a place and accept help is usually reconciled to his disability and willing to go to any length to get help.

2. More time can frequently be allotted to the patient than is feasible in private practice.

3. The patient may be introduced to other benefits available to him at these public or quasipublic agencies which he did not know existed.

We strongly emphasize that it is not to the best interest of the patient simply to send him to an optician for both testing and fitting of the low vision aid, as is sometimes done. The physician is solely responsible for any treatment the patient receives, and he should supervise all procedures and not delegate them to an unsupervised nonmedical refractionist.

Remember that most patients can be helped by using not more than three types of lenses: (a) a high plus add in the form of a reading glass or a half glass; (b) a bifocal of one of the types that is now commercially available with adds up to + 24.00, and (c) one of the best form type lenses which also are now available commercially.

It is also important to emphasize that if the physician has an optician who will cooperate with him and work under his direction, the problems can be easily solved.

Dr. Fonda, can the patient harm his eyes by using them or should any limitation be placed on the use of the eyes?

DR. FONDA: No. So far as I know no congenital, degenerative or healed ocular disease can be aggravated by the use of the eyes. In fact, there is no evidence that pathologic myopia is even aggravated by the use of the eyes. Therefore, if no harm is done by using the eyes, no limitation need be placed upon them. The patient is advised to decide this for himself. Some patients are able to read for two or three hours holding the material 2 inches from their eyes.

## SUMMARY

DR. SNYDACKER: Many people in this country would be benefited by prescription of special lenses for low visual

acuity. Determination of what that prescription should be is not as complicated as it appears on first glance. It is merely an extension of a routine ophthalmic examination with particular attention to determination of the refractive error. In many instances the prescription of a high plus add, either in the form of a reading glass or as a bifocal, will satisfy the patient's needs. The amount of the add to be prescribed is determined empirically, but in general the lower the vision, the higher the add. Up to an add of + 10.00 can be prescribed binocularly, incorporating base in prism in the proportion of 1 prism diopter base in for each diopter of add. Reading additions of over + 10.00 preclude the possibility of binocular vision and are prescribed monocularly for the better eye.

Such high plus adds can be obtained from any regular optician, as can various other types of theoretically more desirable lenses, such as aspheric lenses and combinations of lenses which reduce spherical and chromatic aberration. It is important for the ophthalmologist and optician to work closely together in supplying these lenses.

It must be made clear that any of these devices will enable the patient to read again but they will not permit him to read easily or even with comfort. Reading distance is frequently very short, a matter of an inch or so, and this entails obvious difficulties. Patients who will derive benefit from such lenses must be reconciled to their visual defect and must be strongly motivated to read.

# THE DIAGNOSTIC VALUE OF FLICKER PERIMETRY IN CHRONIC SIMPLE GLAUCOMA

CHARLES J. CAMPBELL, M.D.
M. CATHERINE RITTLER
NEW YORK, NEW YORK

BY INVITATION

THE emphasis of medicine is shifting increasingly in the direction of prophylaxis and early diagnosis. Since early diagnosis is one of the cornerstones in the successful management of chronic simple glaucoma, it is important to evaluate any test that promises aid in this sphere. Previous investigations have indicated that early functional changes resulting from glaucoma may be detected with flicker perimetry. In this report a sensitive technique of flicker perimetry is described and its role in the recognition of glaucoma is indicated.

Preliminary experiments in flicker perimetry were carried out on a few observers to achieve standardization of technique and equipment. Flicker threshold values were then obtained from a large group of normal subjects, and statistical evaluation of these data provided the range of normal responses. Finally, flicker perimetry was studied in patients with proved chronic simple glaucoma. Included in this latter group are patients whose disease process is early, since they have either equivocal or no visual field changes. Analysis of the data obtained from these cases leads us to believe that flicker perimetry can contribute substantially to resolving the problem of diagnostic uncertainty in glaucoma.

From the Knapp Memorial Laboratories, Institute of Ophthalmology, Columbia University College of Physicians and Surgeons, New York.

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We gratefully acknowledge the counsel and encouragement given by Dr. Gertrude Rand. We are also indebted to Dr. Willis S. Knighton and Dr. Andrew de Roetth, Jr., of the Glaucoma Department at the Institute of Ophthalmology, for aiding in the selection of and for the careful study of our patients.

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## HISTORICAL REVIEW

Previously published reports indicate clearly that the history of flicker perimetry is a long and impressive one. Not only the basic mechanisms of flicker perception but also its clinical application have been subjected to careful scrutiny.

In many of the previous reports, however, it is generally true that an inadequate number of normal subjects had been studied. However, in those studies which did include large numbers of normal subjects, the experimental conditions or testing techniques often differed from those adopted for this investigation. The absence of normal statistical information applicable to the current problem imposes rigorous limitations on the evaluation of pathologic data and requires, therefore, that these normal limits be determined. We would be remiss not to acknowledge the circumspect and provocative publications of Havener and Henderson,[1] and particularly of Miles.[2-4] The latter reports distinctly predict the true potential of flicker perimetry in chronic simple glaucoma.

## PRESENT TECHNIQUE

The background for the flickering stimulus is provided by a gray tangent screen of 33 per cent reflectance, illuminated uniformly to a level of six foot-candles. To enhance the clinical usefulness of flicker perimetry the background screen illumination was simply that obtained from the room lighting units.

The flickering stimulus is a stroboscopic neon discharge tube. The color of the lamp varies slightly with the flash frequency, the lower range being a more saturated orange-red color than the upper. However, this color change is not marked. Adjustment of the flash frequency simply alters the duration of the dark interval. The light duration, especially at the lower flash frequencies, remains relatively fixed at 38 to 48 microseconds.

The stroboscopic lamp itself has been mounted in a gray housing attached to the end of a wand. The housing shields the screen from the stray light of the flickering stimulus. A circular aperture cut in the front of the lamp housing provides a stimulus subtending 1.5 degrees. The aperture is covered with a diffuser* to assure uniformity of illumination. An extension taped to the wand connects the lamp to the Strobotac control device (fig. 1). By means of the wand the experimenter may position the stimulus at various locations on the tangent screen.

The control unit for the stroboscopic lamp is the Strobotac manufactured by General Radio Company of Cambridge, Massachusetts. It consists of a power supply and an oscillator which controls the rate at which the lamp is flashed. By turning an illuminated dial, the frequency of the oscillator and hence the flashing speed of the lamp can be adjusted accurately to any value between 10 and 242 cycles per second.

The experiment starts by seating the patient one meter from the tangent screen. One eye is occluded and proper positioning is obtained by placing the chin in the cup of a head-rest. The subject is instructed to maintain careful central fixation, and to indicate with a tap signal when the stimulus appears to

FIG. 1—Stroboscopic apparatus as adapted for flicker perimetry together with lamp housing and gray tangent screen.

flicker. As in all perimetry, it is essential that the patient maintain precise fixation. Flicker and nonflicker are demonstrated. With the stimulus flashing at a high frequency the sensation of a steady light is pointed out to the patient. The rate of flicker is then decreased until the sensation of obvious flicker results. The flicker threshold (cff), it is explained, is the precise transition point between the steady sensation and the flickering sensation. It is important to emphasize that the patient respond with a tap signal at the first appearance of the flicker sensation.

After the demonstration the flicker threshold is determined for the central area and for 26 additional points located on the 10, 17.5, and 25 degree isopters,

*The diffuser is a disc of white, translucent Plexiglas, 0.10 inch thick, and transmits 71 per cent of the visible spectrum for C.I.E. Illuminant C.

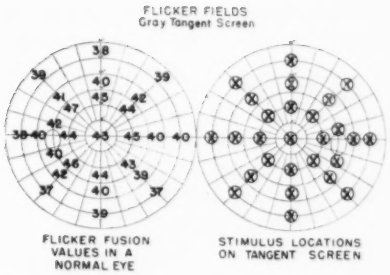


FIG. 2—Example of cff values obtained for the normal eye and designation of the precise locations of the stimulus on the tangent screen.

and around the blind spot. These 27 locations are illustrated in figure 2 together with an example of a normal flicker field. The numbers on the normal field represent the patient's cff values. To determine the flicker threshold at each of these locations, the stimulus first must be placed precisely at the proper location on the tangent screen with the flashing frequency set high enough to produce a steady sensation. The frequency must then be reduced immediately at a rapid and steady rate until the patient signifies that flicker has appeared. Experimental errors may result from either an extended time interval or motion of the stimulus while the frequency rate is being reduced for the threshold determination. These two errors are local adaptation and a motion stroboscopic effect.

Local adaptation has been defined as the changing flicker threshold caused by extended stimulation with a flickering light. The peripheral regions of the retina exhibit local adaptation effects most readily. In these areas changes in flicker threshold occur if there is intermittent stimulation for a period of time greater than 10 seconds. This 10 second value, of course, applies to the experimental conditions that have been outlined. Local adaptation demands then that the flicker threshold be determined well inside 10 seconds. To ensure this requirement, the flashing frequency must be rapidly reduced immediately after the stimulus has been positioned on the tangent screen. It is clear that the threshold must be determined sharply and that the experimenter must refrain from undue fidgeting or fussing with the frequency control knob in an effort to obtain a more satisfying endpoint. Periodically, in our experiments, random checks were made of the time necessary to obtain the threshold. In general this interval did not exceed 4 seconds. Local adaptation, however, is of sufficient importance to demand constant vigilance and attention.

A motion stroboscopic effect occurs if the flickering stimulus is not absolutely still for the threshold determination. Slight movement of the stimulus will result in the sensation of flicker even if the flash rate is considerably above the cff frequency. It is clear then that the flickering stimulus cannot be used like a movable test object in conventional perimetry.

Preliminary experiments have been carried out to determine the optimum stimulus size, the most satisfactory stimulus intensity, and the most favorable level of illumination for the surround. These conditions have been described and are utilized in the present investigation. Experiments have also shown that within wide limits it is unnecessary to correct the patient's refractive error.

The data obtained with flicker perimetry were compared with those obtained from conventional visual fields. In recording the conventional visual fields the observer was located at a distance of one meter from a black tangent screen uniformly illuminated to a level of 17 footcandles by Macbeth daylight lamps. The white or red test objects were spherical in shape and were mounted on a black wand.

The technicians for this study were carefully selected to reduce the chance of

experimental bias. They were not instructed that flicker perimetry was the specific object of the investigation. On the contrary, it was implied that all patients with chronic simple glaucoma are studied routinely with both tangent screen perimetry and flicker perimetry. Futhermore, at the start of the program, the technicians were untrained in both techniques and therefore were instructed simultaneously in the two procedures.

### NORMAL OBSERVERS

A series of 92 normal eyes in patients ranging from 10 to 70 years have been investigated. These eyes were established as normal only after a complete ophthalmologic examination. Figure 2 shows the flicker threshold values obtained for a normal observer. Inspection of this figure suggests clearly that a different method of recording would enhance the clinical value of flicker perimetry. A new recording system should differentiate abnormal from normal findings, and further should quantitate the magnitude of the abnormality found. Achievement of these goals should present to the clinician an intuitively clear picture which does not require memorized data or calculations.

A more satisfactory method of presenting information has been developed, in part, from our statistical study of normal subjects. First, the normal flicker field must be defined. This means that a value must be found for each point in the flicker field, below which the cff is clearly abnormal. We have attempted to resolve the normal-abnormal boundary problem on a statistical basis. Accordingly from the normal data a mean and standard deviation have been calculated for each isopter. These values were utilized to determine the cff which represents the low normal response for any selected chance variation.

Chance variation figures are important in defining the limits of the normal range because they indicate the likelihood, expressed as a ratio, that a given flicker frequency in a specific isopter is a normal response. Figure 3 illustrates the

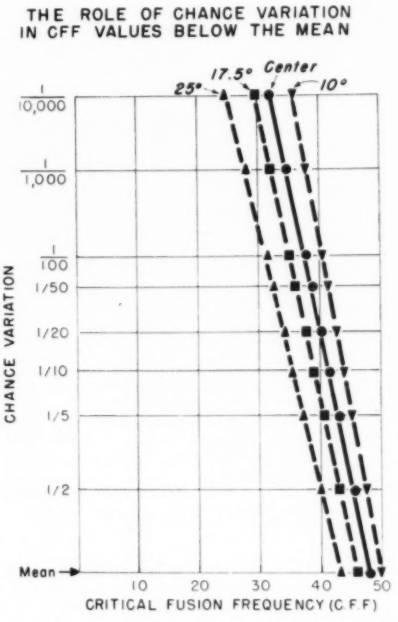


FIG. 3—Relation of low normal cff values to different chance variation ratios at each isopter.

relation between low normal cff values and various chance variation ratios. The chance variation figure of 1:50 has been arbitrarily selected as the lower limit of normal. Table I summarizes the mean, standard deviation, and low normal values, and in Figure 4 the lower limit of normal for each isopter is illustrated.

To facilitate recording and interpretation, all cff. values equal to or above the low normal range should be considered normal and recorded as N in the diagram. Lower cff values due to reductions in flicker sensitivity must then be indi-

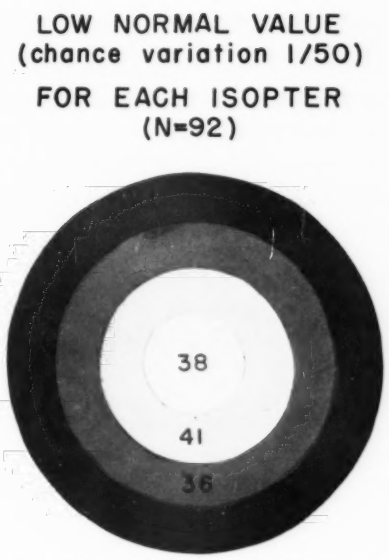


FIG. 4—Lower limit of normal for each isopter as defined by the chance variation factor 1:50.

cated in another manner. The frequency itself would not be especially meaningful since the low normal values are different for each isopter. On the other hand, a per cent reduction would provide an immediate quantitative estimate of the departure from normal. Per cent reduction is defined as the percentage that any value is reduced below the lower limit of normal. In algebraic terms it is as follows:

$$\% \text{ Reduction} = \frac{\text{Normal CFF} - \text{Patient's CFF}}{\text{Normal CFF}}$$

The per cent reduction technique requires that the experimenter consult a simple chart, table II, after each threshold has been determined. Table II indicates the per cent reduction of all abnormal flicker values for each isopter.

TABLE I

MEAN, STANDARD DEVIATION, AND THE LOW NORMAL CFF VALUE FOR EACH ISOPTER

| ISOPTERS | MEAN | STANDARD DEVIATION | LOW N VALUE (1/50) |
|---|---|---|---|
| Center | 48.1 | 4.2 | 38.0 |
| 10.0 | 49.7 | 3.7 | 41.0 |
| 17.5 | 45.8 | 4.2 | 36.0 |
| 25.0 | 43.1 | 4.6 | 32.0 |

TABLE II

CONVERSION TABLE FOR CFF VALUES TO PER CENT REDUCTION IN EACH ISOPTER

| | PER CENT REDUCTION | | | |
|---|---|---|---|---|
| CFF* | CENTER | 10.0° | 17.5° | 25.0° |
| 41 | N | N | N | N |
| 40 | N | 2 | N | N |
| 39 | N | 5 | N | N |
| 38 | N | 7 | N | N |
| 37 | 3 | 10 | N | N |
| 36 | 5 | 12 | N | N |
| 35 | 8 | 15 | 3 | N |
| 34 | 11 | 17 | 6 | N |
| 33 | 13 | 20 | 8 | N |
| 32 | 16 | 22 | 11 | N |
| 31 | 18 | 24 | 14 | 3 |
| 30 | 21 | 27 | 17 | 6 |
| 29 | 24 | 29 | 19 | 9 |
| 28 | 26 | 32 | 22 | 13 |
| 27 | 29 | 34 | 25 | 16 |
| 26 | 32 | 37 | 28 | 19 |
| 25 | 34 | 39 | 31 | 22 |
| 24 | 37 | 41 | 33 | 25 |
| 23 | 39 | 44 | 36 | 28 |
| 22 | 42 | 46 | 39 | 31 |
| 21 | 45 | 49 | 42 | 34 |
| 20 | 47 | 51 | 44 | 38 |
| 19 | 50 | 54 | 47 | 41 |
| 18 | 53 | 56 | 50 | 44 |
| 17 | 55 | 59 | 53 | 47 |
| 16 | 59 | 61 | 56 | 50 |
| 15 | 61 | 63 | 58 | 53 |
| 14 | 63 | 66 | 61 | 56 |
| 13 | 66 | 68 | 64 | 59 |
| 12 | 68 | 71 | 67 | 63 |
| 11 | 71 | 73 | 69 | 66 |
| 10 | 74 | 76 | 72 | 69 |

*The CFF column on the left refers to the experimentally determined threshold value.

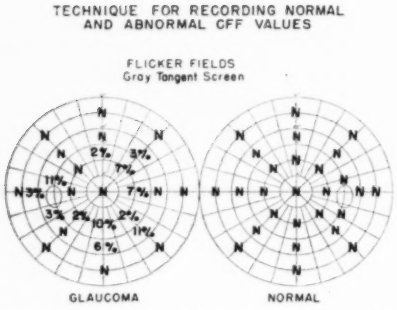


FIG. 5—Normal and pathologic flicker fields in which the normal cff values are recorded as N and the abnormal responses in terms of per cent reduction.

Figure 5 illustrates this technique of recording data. The patient had chronic simple glaucoma and, whereas extensive areas are within normal limits, other areas exhibit flicker sensitivity below normal. In the latter regions the numbers indicate the per cent reduction in flicker sensitivity. Recording normal responses simply as N and abnormalities as per cent reduction provides an immediate picture of the patient's flicker field.

### CHRONIC SIMPLE GLAUCOMA

All patients with chronic simple glaucoma have been studied by persons in the glaucoma department at the Institute of Ophthalmology. They have been examined repeatedly and their examinations have consisted of clinical evaluation, gonioscopy, measurement of the intraocular pressure, tonography, the water drinking test, inspection of the optic discs, and visual fields. Persons in the glaucoma department have established our diagnostic criteria:

1. Tension 30 mm. or greater
2. Water drinking test positive
   a. Tension increase of 6 mm. or more
   b. Final tension greater than 30 mm.
3. Aqueous flow (without drops) C = 0.10 or less

At least one of these requirements was met by all patients included in this investigation. Since we believe that all of these patients constitute proved cases of chronic simple glaucoma, each had his disease process under satisfactory control with pilocarpine. The reduced pupil size caused by pilocarpine may produce experimental errors in flicker fusion studies. For this reason pilocarpine was discontinued 48 hours before the flicker perimetry was done.

A total of 35 eyes with chronic simple glaucoma have been studied with flicker perimetry and they may be divided into two groups. The first group, consisting of 23 eyes, are those with either equivocal or no visual field changes. The second are those eyes, 12 in number, with definite visual field defects.

Only 4 of the total of 35 eyes with proved chronic simple glaucoma showed entirely normal flicker responses. All cases with definite visual field changes exhibited marked departures from normal in flicker sensitivity. The more interesting group, however, are those 23 eyes with equivocal or no visual field changes, since they constitute a potential diagnostic problem. Of these, 82.6 per cent showed pathologic flicker responses. This is truly a significant figure when we remember that the normal-abnormal boundary has been defined by a chance variation value of 1:50. The high sensitivity of flicker perimetry and its value in clarifying the total functional picture for the individual case is illustrated in table III.

TABLE III

PERTINENT INFORMATION IN EACH EYE WITH CHRONIC SIMPLE GLAUCOMA STUDIED BY FLICKER PERIMETRY

| | GLAUCOMA STUDIES | | | | | FIELD STUDIES | |
|---|---|---|---|---|---|---|---|
| AGE | VISUAL ACUITY | DISC CUPPING | MAXIMUM TENSION* | AQUEOUS FLOW | WATER DRINKING | ABNORMALITY OF CONVENTIONAL VISUAL FIELDS | REDUCTION OF FLICKER FUSION FIELDS |
| 45 | 20/15 | No | 30/40 | 0.08 | Not Done | None | Moderate |
| 45 | 20/15 | No | 29/40 | 0.06 | Not Done | None | Moderate |
| 66 | 20/20 | No | 31/28 | 0.16 | 20-31 | None | Moderate |
| 66 | 20/20 | No | 29/26 | 0.19 | 20-24 | None | Moderate |
| 57 | 20/60+2 | No | 29/33 | 0.11 | 27-29 | None | Slight |
| 57 | 20/25—1 | No | 29/28 | 0.11 | 29-29 | None | Slight |
| 64 | 20/30+1 | No | 37/26 | 0.18 | 24-37 | Slight | Moderate |
| 64 | 20/20 | No | 34/26 | 0.05 | 22-34 | None | Moderate |
| 70 | 20/20—2 | No | 36/36 | 0.13 | 24-36 | None | None |
| 70 | 20/25—2 | No | 37/44 | 0.17 | 27-37 | None | None |
| 44 | 20/15 | No | 32/20 | 0.26 | 26-30 | None | None |
| 44 | 20/20+2 | No | 30/30 | 0.21 | 27-30 | None | None |
| 48 | 20/20— | No | 24/42 | 0.12 | Not Done | None | Moderate |
| 48 | 20/20— | No | 50/46 | 0.10 | Not Done | None | Moderate |
| 59 | 20/20—2 | ? | 27/36 | 0.10 | Not Done | None | Slight |
| 59 | 20/20 | Yes | 28/48 | 0.16 | Not Done | None | Moderate |
| 55 | 20/20 | No | 45/35 | 0.07 | Not Done | None | Moderate |
| 55 | 20/20 | No | 40/35 | 0.06 | Not Done | None | Moderate |
| 73 | 20/20 | Yes | 36/45 | 0.09 | Not Done | None | Slight |
| 73 | 20/20—2 | Yes | 46/52 | 0.09 | Not Done | None | Slight |
| 61 | 20/20 | No | 37/35 | 0.09 | Not Done | None | Slight |
| 61 | 20/20 | No | 37/35 | 0.12 | Not Done | None | Slight |
| 68 | 20/25 | ? | 34/30 | 0.06 | 27-34 | None | Moderate |
| 68 | 20/20 | ? | 29/33 | 0.10 | Not Done | Slight | Marked |
| 66 | 20/100 | Yes | 29/33 | 0.08 | Not Done | Marked | Marked |
| 68 | 20/50 | ? | 34/32 | 0.05 | 27-34 | Moderate | Moderate |
| 49 | 20/15 | Yes | 30/35 | 0.12 | 24-30 | Moderate | Marked |
| 49 | 20/15 | Yes | 30/35 | 0.14 | 26-30 | Moderate | Marked |
| 85 | 20/40 | No | 35/46 | 0.07 | Not Done | Moderate | Marked |
| 85 | 20/40 | No | 35/49 | 0.07 | Not Done | Moderate | Marked |
| 65 | 20/25 | No | 37/29 | 0.06 | Not Done | Moderate | Marked |
| 65 | 20/25 | No | 37/29 | 0.07 | Not Done | Moderate | Marked |
| 58 | 20/30 | Yes | 52/29 | 0.03 | Not Done | Marked | Marked |
| 58 | 20/15 | Yes | 46/29 | 0.05 | Not Done | Moderate | Marked |
| 67 | 20/25 | No | 25/28 | 0.12 | Not Done | Moderate | Moderate |

*Maximum tension taken in glaucoma clinic/Maximum tension taken in eye clinic.

Sample flicker fields are shown in Figures 6 through 10. The first two figures also include corresponding visual fields of the type we have characterized as either normal or equivocally normal. The intensity of shading indicates the approximate reduction in flicker sensitivity. Figure 9 shows two of the four eyes in which both the flicker values and visual fields are within normal limits. Figure 10 illustrates cases with definite visual field defects and correspondingly marked flicker abnormalities. These extreme flicker abnormalities are the type generally associated with definite changes in visual fields. The likelihood that these flicker values could result from a chance variation of normal is extremely remote.

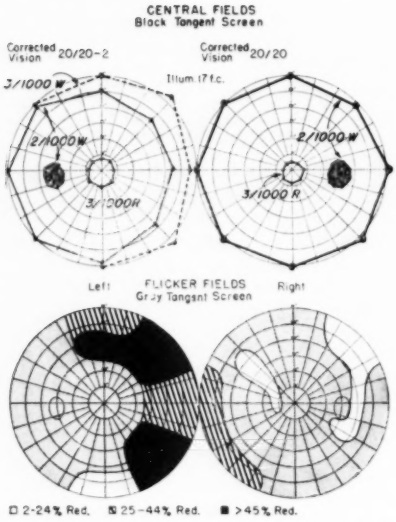


FIG. 6—Two eyes with chronic simple glaucoma exhibiting either normal or equivocally normal visual fields and extensive flicker abnormalities.

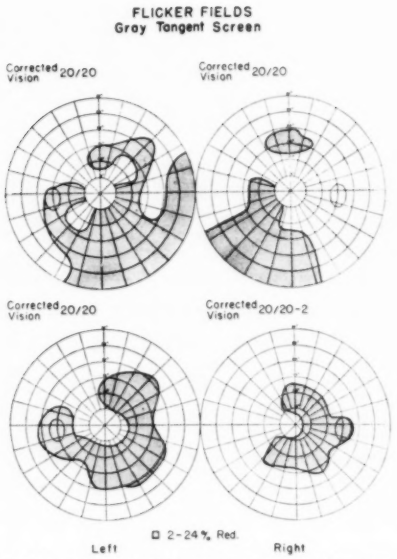


FIG. 8—Abnormal flicker fields and normal or equivocally normal visual fields obtained from four eyes with chronic simple glaucoma.

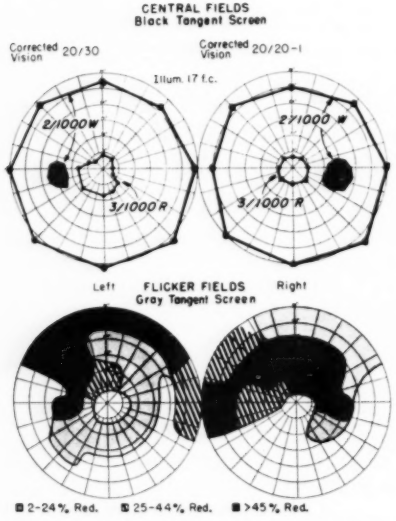


FIG. 7—Two eyes with chronic simple glaucoma exhibiting either normal or equivocally normal visual fields and extensive flicker abnormalities.

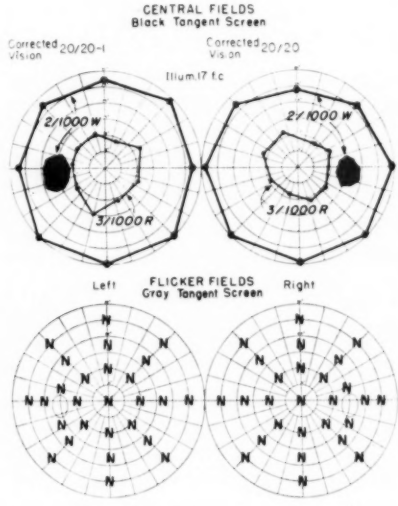


FIG. 9—Two eyes with proved chronic simple glaucoma showing normal conventional visual fields and normal flicker fields.

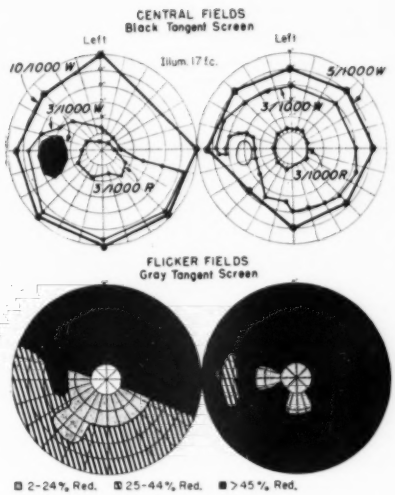


FIG. 10—Two eyes with proved chronic simple glaucoma showing extensive abnormalities with both conventional and flicker perimetry.

Data alone are not entirely adequate to focus clearly the clinical role of a new testing procedure. In order to achieve wide use, the test should be administered easily by the average technician. The equipment must be designed for use in conjunction with the space and facilities conveniently available. Furthermore, the naive patient should be able to make reproducible judgments, and the test must be completed in a reasonable length of time. We feel that flicker perimetry meets these requirements. In general, the administration of the test requires approximately 20 minutes. On questioning, most patients have found that the judgments in flicker perimetry are easier and more satisfying than in visual fields. Technicians have been trained in perhaps less time than is required for ordinary perimetry.

## CONCLUSIONS

A technique of flicker perimetry has been described and values determined for a series of normal subjects. Using this procedure, data have been collected and analyzed from a group of patients with chronic simple glaucoma. The patients consisted of those with equivocal or no visual field changes and those with definite visual field loss. These patients have been carefully studied by the glaucoma department. Many flicker abnormalities were found in those patients with early manifestations of the disease, and 100 per cent of those patients with definite visual field loss exhibited abnormal flicker responses. On the basis of these findings and of technical facility, it is believed that flicker perimetry offers a useful adjunct to the study of early chronic simple glaucoma.

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## DISCUSSION

PAUL W. MILES, M.D., St. Louis: It is always a pleasure to have one's work confirmed. As many of you know, I gave a paper on this subject in 1950 expressing the belief that flicker perimetry is a valuable tool in the early diagnosis of glaucoma. I am very grateful to Dr. Campbell and his associates for continuing this study. I have used four different types of flicker generators, and consider the Strobotac with its bright orange flash as used by Dr. Campbell to be the best.

Flicker perimetry in my hands has been valuable for initial diagnosis in all cases, but

in recent years I have stopped using it for follow-up studies. It is too sensitive. One may get the idea that vision is failing fast until one takes a standard field and finds it nearly normal. In my office I have the flicker apparatus set up permanently with my tangent screen. I use them together and put both records on the same card.

The late Lawrence Post, Sr., once told me that flicker perimetry would be slow in gaining popularity as long as the record consisted of a group of numbers. Attempts have been made to simplify the record of the field to make it readable. The method proposed by Dr. Campbell using a group of letters or of percentages is still not simple and easy.

Using the absolute flicker rate numbers has been useful to me. It probably does look strange at first, but so did the first electrocardiograph tracings. In the spots which I consider abnormal, I make hatch marks, just as one would darken the defective areas of an ordinary central field. The absolute number shows through as a permanent record which doesn't require a formula, key or table.

Dr. Campbell has used a rational and scientific approach by making each reading a percentage of an average normal figure. However, I abandoned this idea a long time ago because I cannot establish a normal flicker field. The normal figures [shown in slide] could all be changed plus or minus four points and the field would still be normal in my opinion. On the other hand, a drop of three flashes per second in any one area of a field should be considered abnormal.

My criteria for saying a flicker field suggests glaucoma are, therefore, different from those criteria given by Dr. Campbell, although we have come to the same conclusions. He uses a fixed normal as a control, while I use the patient's own flicker field, or that of his other eye, as a control. This is, perhaps, not as scientific, but it is practical.

Let me illustrate briefly how I analyze a flicker field. [Slide] This is a normal field. For suspected neuro-ophthalmic lesions, I compare paired readings across the vertical line, including paired corner readings. In suspected glaucoma, I compare paired readings across the horizontal line. The abnormal finding is a difference of three or more points in one of a pair of readings.

[Slide] This is a flicker field series in a case of early glaucoma. Notice the hatch marks indicating flicker rates which are less than expected by comparison across the line. Hatch marks above and below the disc indicate flicker rates there which are low by comparison with the figures in adjacent areas.

[Slide] I have used this method for observing the effect of a certain treatment. The readings to the left are the initial ones, and the two subsequent readings are given only by construction on squared graph paper. Each square represents a difference of two flashes per second, between the initial field test and the ones following. By making the left end of the sloping line represent Dr. Campbell's average normal control, and the final position the relative flicker rate of the patient, a fairly simple system of recording might result.

DR. CAMPBELL: I would like to thank Dr. Miles for his careful consideration of our paper, and especially for the detailed and meticulous attention he applied to our four cases of chronic simple glaucoma and normal flicker responses.

We did utilize his comparison technique in evaluating our data. It is more sensitive. We feel, however, that the simplification offered by the method described in this report more than offsets any slight reduction in sensitivity.

# CYSTINOSIS

L. K. Garron, M.D.
SAN FRANCISCO, CALIFORNIA

Cystinosis is a rare disorder of infants and children characterized by widespread deposition of cystine crystals in many tissues of the body. Chiefly affected are the bone marrow, kidneys, liver, spleen, adrenal glands, lymph glands, and eyes. The clinical manifestations of the disease are those of the Fanconi or Lignac-Fanconi syndrome, i.e., some or all of the following: dwarfism, renal rickets, acidosis, hypophosphatemia, nondiabetic glycosuria, and aminoaciduria. The only recorded exception is the single case reported by Cogan and his colleagues[4,5] who found indisputable evidence of ocular cystinosis in an adult who showed no other signs of the Lignac-Fanconi syndrome. This is also the only known case of cystinosis in an adult.

The disease is thought to be the result of inborn defects in kidney-tubule function which are usually in evidence before the child is two years old. Normally the amino acids, glucose, water, and such electrolytes as potassium and the phosphates, are secreted or filtered by the glomeruli into the renal tubules, and are then reabsorbed into the circulation for metabolic use. In cystinosis the tubular reabsorption process is defective and hypophosphatemia, nondiabetic glycosuria, hypopotassemia, and aminoaciduria supervene. Often there is also a renal defect in the secretion of hydrogen ions which results in acidosis. Progressively there is kidney damage and the development of chronic glomerulonephritis and renal rickets. Eventually, as a rule before age ten, death ensues from uremia or from intercurrent infection to which children so affected are highly susceptible.

Bürki[1,2] was the first to describe the ocular signs of cystinosis (1941). He found clinical and microscopic evidence of cystine deposits in the conjunctiva and cornea and histologic evidence also in the episclera, sclera and uveal tract. With powerful illumination or the slit lamp, the ophthalmologist can recognize the presence of cystine deposits in the cornea and conjunctiva; they characteristically appear as myriad deposits of fine refractile crystals in the anterior corneal stroma and superficial layers of the conjunctiva. Since such recognition constitutes presumptive evidence of similar depositions elsewhere in the body, the diagnostic value of the ocular findings can be very great indeed.

The ocular findings and autopsy report are summarized in the following case history.

## CASE REPORT*

C. D., a white girl residing in the Midwest, was first observed clinically at the age of 28 months because of severe vomiting, polydipsia, and polyuria. Her condition was diagnosed as diabetes insipidus and pitressin therapy was instituted. Four months later she was referred to a midwestern medical center

From the Department of Ophthalmology and the Francis I. Proctor Foundation for Research in Ophthalmology, University of California School of Medicine, San Francisco.

Appreciation is expressed for the helpful advice of Dr. Harold Harper, Department of Surgery, University of California School of Medicine.

Presented as a *Clinicopathologic Case Report* at the Sixty-Third Annual Session of the American Academy of Ophthalmology and Otolaryngology, Oct. 12-17, 1958, Chicago.

*Appreciation is expressed to Dr. Edward B. Shaw, Chairman of the Department of Pediatrics, for his permission to report this case.

for extensive study and for regulation of the pitressin treatment. Blood counts were normal except for slight anemia. The urine occasionally showed albumin and had a specific gravity of 1.002. The nonprotein nitrogen was slightly elevated. Roentgenograms of the long bones, as well as intravenous and retrograde pyelograms, were normal.

The pitressin injections were continued until the child was 3 years and 6 months old and were then stopped. The polyuria and polydipsia were milder in degree but still present, with frequency five to ten times daily and three to four times nightly.

On April 8, 1956, when 7 years and 10 months old and residing in California, the patient was admitted to the Pediatric Service of the University of California Hospital for evaluation of her history of diabetes insipidus. Five days previously she had developed an upper respiratory infection with a temperature of 101 F., persistent vomiting and dehydration. On admission, her hemoglobin concentration was 8.7 grams per cent, there was a 4 plus albuminuria, the specific gravity of the urine was 1.006, and the urea nitrogen was 63.80 per cent. She was given terramycin for the infection and pitressin for the diabetes insipidus.

*Physical Examination*

The patient was a very pale, somewhat ashen, lethargic child who looked chronically ill (fig. 1). She was dwarfed (height 103.7 cm. or 41 inches, weight 16.7 kgm. or 37 pounds) and her skin was pasty, dry and scaly. The liver and spleen were palpable. In addition to the history of polydipsia and polyuria, a history of marked craving for salt was elicited. Since birth she had been intolerant to heat and had never perspired. Until age four she had shown no evidence of lacrimation and during the past year had been photophobic.

*Eye Examination*

When illuminated with a flashlight, the corneas looked glazed, and on slit lamp examination a mass of fine, polychromatic, sparkling crystals could be seen infiltrating the corneal stroma (fig. 2) and bulbar conjunctiva diffusely. Unfortunately no record was made of the precise localization of the crystalline deposit in the cornea, but it was the impression of a number of observers that at least the outer third of the stroma of the cornea was involved. As in the cases reported by Cogan and others,[3] the crystals extended across the limbus without leaving a clear zone.

FIG. 1—Patient at left compared with normal child of the same age.

The visual acuity of each eye was 20/40. Fundus examination was hampered by the corneal haze but the fundi appeared to be normal.

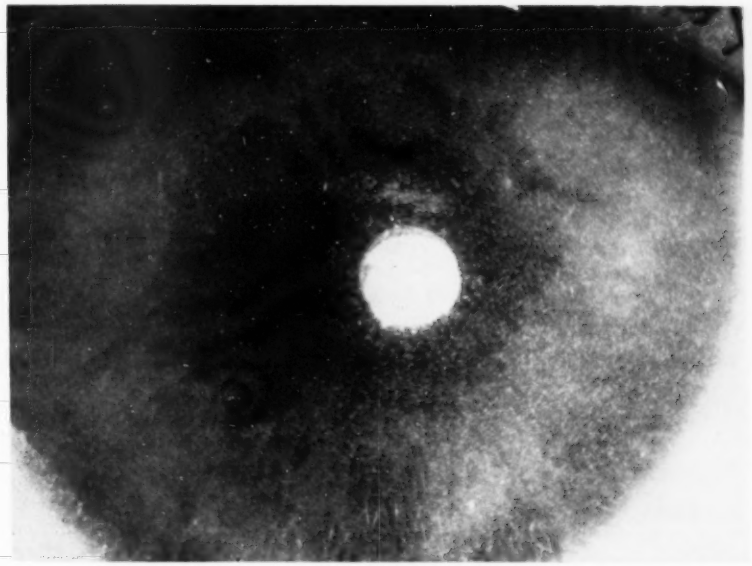

FIG. 2—Scintillating cystine crystals distributed diffusely over the cornea and extending to the limbus without leaving a clear zone. The abundance of crystals was readily apparent with focal illumination.

*Laboratory Examination*

*Blood studies.* The blood level of carbon dioxide was 15 mEq./L.; of sodium, 134 mEq./L.; of chloride, 100 mEq./L.; of potassium, 3.7 mEq./L.; of calcium, 9 mg./100 ml.; of phosphorus, 8.7 mg./100 ml.; of creatinine, 4.4 mg./100 ml.; of albumin, 3.9 gm./100 ml.; of globulin, 4.2 gm./100 ml.; and of urea nitrogen, 68.1 mg./100 ml. Eight days later the urea nitrogen had increased to 95.1 mg./100 ml.

*Urinalysis.* Specific gravity was 1.004 to 1.010; pH, 5.5 to 7.0; albumin 2 plus. A 24-hour urine assay for total amino acid nitrogen yielded 62 mg. per liter.

*Roentgenograms.* The long bones showed changes characteristic of rickets. Although the child's age was almost 8 years, her bone age according to Todd's *Atlas* was 5 years and 3 months.

*Biopsies.* Crystals were demonstrated in a bone marrow biopsy but were not certainly identifiable as cystine. A conjunctival biopsy of the right eye showed masses of rectangular and square crystals in the subepithelial zone resembling cystine.

The diagnosis was cystinosis and chronic uremia.

*Clinical Course*

The patient was treated in the Pediatric Metabolic and Renal Clinic and seemed to progress reasonably well on a regime of vitamins, Amphojel, mol iron, and sodium citrate. As time went on, however, she had repeated episodes of epistaxis that were often difficult to stop, and gradually became more anemic, the hemoglobin concentration falling from a high of 10 gm. per cent to 5.8 gm. per cent.

In January 1957, her glomerular filtration rate was measured at the Stanford Pediatric Clinic by means of a test in which the clearance of inulin was used as an indicator. She was found to clear only 4 to 5 ml. per minute, a rate corresponding to about 8 per cent of the rate in a normal adult.

Her second admission to the University of California Hospital was on August 14, 1957, after a prolonged bout of epistaxis. Following a transfusion she showed marked symptomatic improvement. During this period of hospitalization the hemoglobin concentration was 8.5 gm. per cent; white blood cell count, 3,900; platelets, 92,000; carbon dioxide, 15.1 mEq./L.; and urea nitrogen, 90 mg./100 ml.

On September 3, 1957, the child was admitted to the Hospital a third time in marked respiratory distress and with a temperature of 100 F. Three days previously she had developed a cough, sputum and dyspnea. These symptoms steadily worsened and there was every clinical indication of uremic pneumonitis, anemia, and cardiac failure. Her condition deteriorated and she died the following day.

*Pathology*

A complete autopsy was performed by the pathology department of the University of California. Pertinent excerpts from the report (#UA 57-221) are summarized as follows:

The diagnosis of cystinosis was established on the basis of cystine deposits in the bone marrow, spleen, liver, lymph nodes, adrenal glands and kidney. Other significant findings included glomerulonephritis, hepatosplenomegaly, renal rickets, anemia, hyperplasia of the parathyroid glands and osteomalacia.

From the bone marrow, "touch" preparations revealed large numbers of clear cystine crystals, varying in shape from rectangular to hexagonal, which resembled those observed in the conjunctival biopsy. In stained sections of other organs in which similar deposits were demonstrable, the crystals were yellowish and varied considerably in size and shape, often appearing rounded and clumped (fig. 3). In some instances they were found within the cytoplasm of the reticuloendothelial cells; in others they appeared extracellularly in localized deposits with minimal reactions in the neighboring tissues. In the kidney (fig. 4), however, where a considerable amount of renal damage and scarring indicated glomerulonephritis, the cystine deposits were found for the most part adjacent to areas of tubular degeneration and glomerular sclerosis.

It is noteworthy that tissues fixed in absolute alcohol, and later subjected to a rapid staining technique, contained an abundance of cystine crystals, whereas tissues fixed in 10 per cent neutral aqueous formalin and stained by standard methods apparently contained few or none.

*Eye Examination*

Both eyes were removed at autopsy and sent fresh to the Eye Pathology Laboratory. The elapsed time from the death of the patient to the fixation of the eyes was approximately 24 hours so that there was considerable postmortem autolysis. The right eye was fixed in absolute alcohol and the left in 10 per cent neutral formalin. Fixation in formalin was a most unfortunate choice: when sections of the left eye were studied microscopically, no evidence of cystine deposition in the tissues could be found. It was learned later that cystine tends to dissolve out of tissues that remain in aqueous solution for a protracted period during fixation or in the staining process.

Before fixation the enucleated eyes were examined with the slit lamp; in

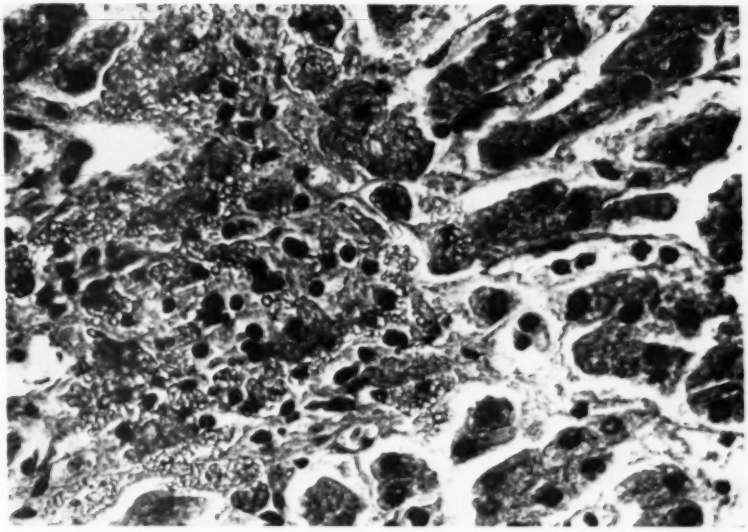

FIG. 3—High-power photomicrograph of liver section (H & E) showing a portion of a lobule packed with cystine crystals.

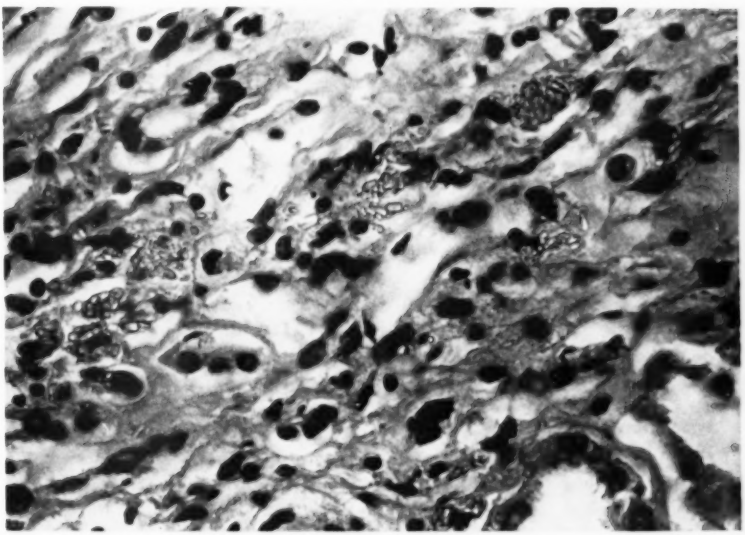

FIG. 4—High-power photomicrograph of kidney section (H & E) with irregular groupings of crystals in the tissue. Note disorganization and degeneration of tubules and interstitial tissue resulting from long-standing glomerulonephritis.

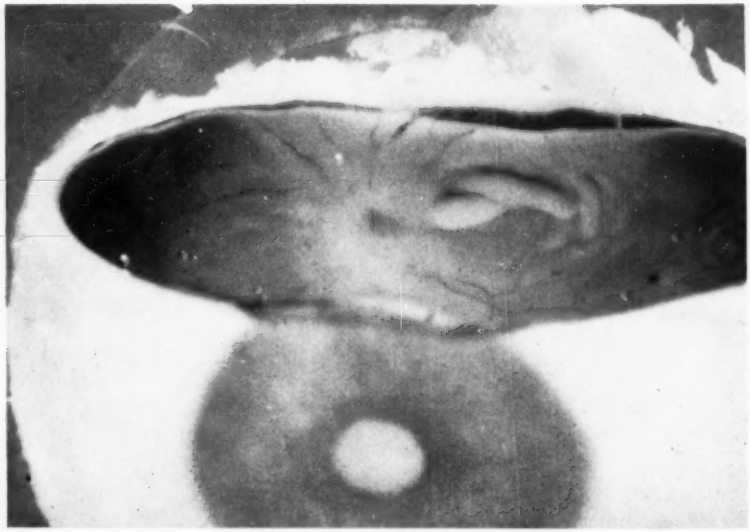

FIG. 5—Gross photograph of the sectioned eye showing papilledema. Wrinkling of the retina about the macula is artifactual.

neither eye was there any evidence of the corneal crystals that had been so readily demonstrable *in vivo*. We were unable to explain this deficiency but speculated on the possibility that the eyes had been placed in saline solution prior to fixation.

The findings in the right eye (EP-57-550) were as follows:

*Gross findings.* The specimen measured 21x22x22 mm. The globe was shrunken, collapsed, and semi-opaque as a result of alcohol fixation. It was opened horizontally. The lens was *in situ* but was opaque, its color chalkwhite (fixation). The vitreous was apparently coagulated anteriorly and numerous gray strands traversed the vitreous chamber. Posteriorly there was an escape of liquid vitreous. The nervehead showed papilledema (fig. 5). The retina was wrinkled, probably artifactually. Other details of structure could not be interpreted because of tissue opacity. The eye was embedded in paraffin.

*Microscopic findings* (partial). The section of the eye was distorted and collapsed. The cornea and iris were approximated so that the anterior chamber was obliterated (artifactually). Beneath the epithelium of the conjunctiva were many accumulations of large numbers of cystine crystals which appeared as yellowish refractile bodies (figs. 6 and 7) oblong in shape and measuring from 5 to 15 micra in length. Their recognition was facilitated by the use of polarized light through the microscope.

The subepithelial zone of the cornea contained only an occasional crystal, which seemed extraordinary in view of the profuse deposition seen clinically. The episcleral tissue and the outer scleral lamellas contained many small clumps of crystalline deposits, none of them surrounded by an inflammatory reaction; even the ligamentous attachments of the rectus muscles and of the inferior oblique were diffusely infiltrated (fig. 8).

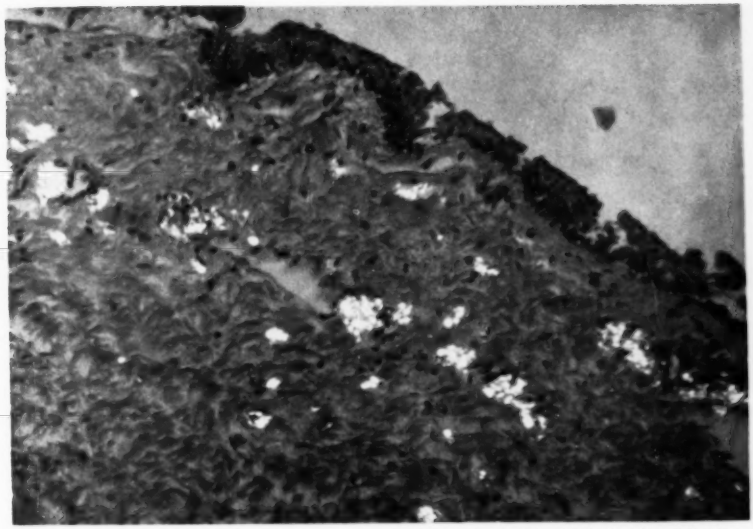

FIG. 6—Low-power photomicrograph of conjunctival section taken with polarized light. Collections of cystine crystals are irregularly distributed in the subepithelial tissue.

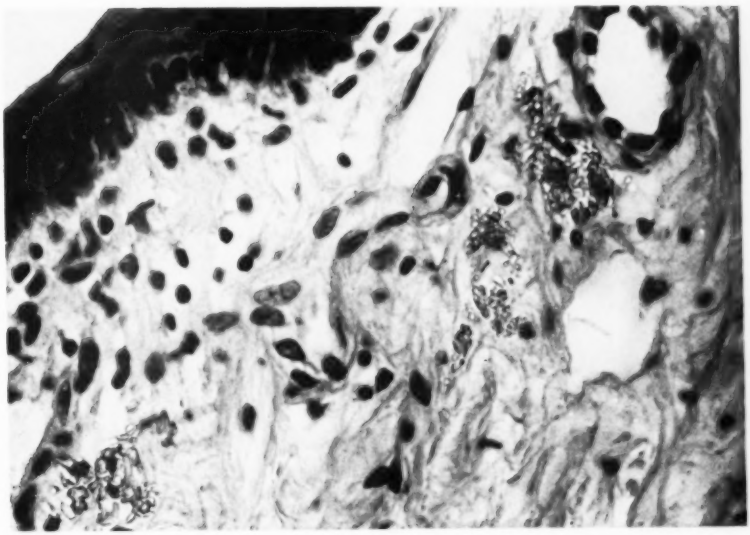

FIG. 7—High-power photomicrograph of conjunctival section (H & E) with crystalline deposits in areolar tissue. Note absence of inflammatory reaction about crystals.

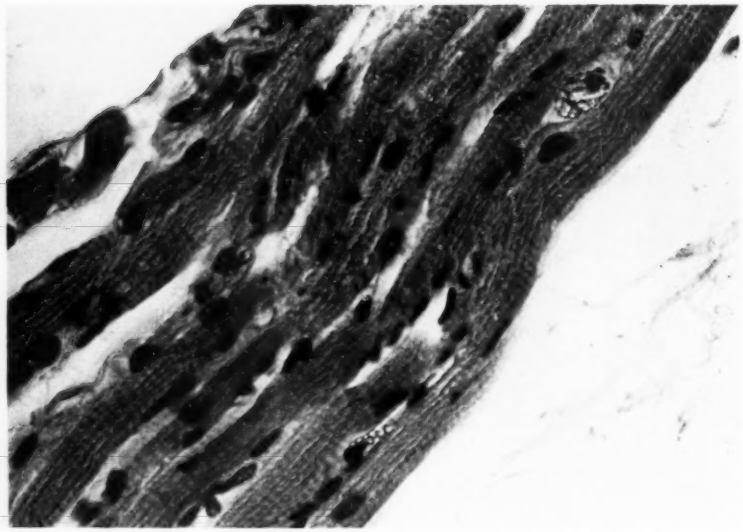

FIG. 8—Photomicrograph of section of inferior oblique muscle (H & E) showing deposition of cystine crystals between muscle fibers.

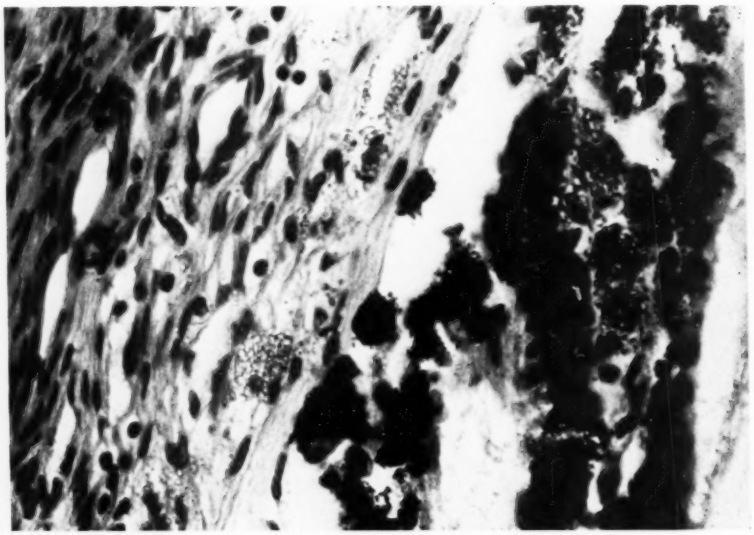

FIG. 9—High-power photomicrograph of sections of ciliary body. Deposits of crystals are seen in the vascular layer of the corona as well as in the stroma of the processes.

The iris contained no crystals. The pigment epithelium of the iris and ciliary body showed postmortem degenerative changes. In the ciliary processes (fig. 9), dense deposits of cystine crystals were found surrounding capillaries of the stroma. In other instances the crystals appeared to be intracellular, in macrophages. Similar crystalline deposits in smaller groups were spread diffusely throughout the ciliary muscles and in the stroma of the pars plana. The choroid was artifactually compressed but a diffuse distribution of cystine crystals could be seen along its entirety.

The retina was artifactually detached and fragmented and showed considerable postmortem change. There was a moderate papilledema of the nervehead.

*Diagnosis*

1. Cystinosis with cystine deposits in the conjunctiva, ciliary body, choroid, sclera, episclera and extraocular muscles.

2. Papilledema, secondary to glomerulonephritis and uremia.

The cystine deposition in the right eye appeared to be for the most part extracellular, but in a few areas there were apparently also intracellular inclusions in macrophages. This interpretation was strengthened by a microscopic study of the left eye: in areas from which it could be assumed that the cystine deposits had been dissolved out by prolonged formalin fixation, large macrophagic cells containing fine pigment granules could be seen. Since these phagocytes were not found in the right eye, it was concluded that intracellular cystine deposits had obscured their outlines.

## COMMENT

Since the characteristic appearance and distribution of crystals in the cornea is pathognomonic of cystinosis, the importance of a careful slit lamp examination in all suspected cases cannot be overemphasized. The cystine crystals have a predilection for the superficial corneal stroma and extend peripherally into the conjunctiva without leaving a clear zone near the limbus. Cogan and his colleagues[3] feel that the biomicroscopic findings are so distinctive that biopsy studies are unnecessary. The crystals appear as scintillating refractile bodies, often polychromatic in character.

Douglas and Bickel[6] attribute the photophobia in these cases to dystrophic changes in the corneal epithelium detectable by fluorescein—apparently a form of superficial punctate keratopathy. It is difficult to explain why there should be staining of the epithelium in these cases unless the deposit of crystals in the superficial stroma interferes with the metabolism of the epithelium. On the other hand, it seems that the diffuse distribution of cystine crystals in the cornea could, by effecting an irregular diffraction of light, produce a glare or dazzle phenomenon and a photophobia comparable to that experienced by cataract patients.

Cystine crystals were found in sections of the inferior oblique and rectus muscles. If similar depositions are characteristic of the musculature of the body elsewhere, muscle biopsies could have considerable diagnostic value.

## SUMMARY

A case of cystinosis characterized by dwarfism, renal rickets, and deposition of cystine in tissues is reported. The diagnosis was established clinically by slit lamp findings in the cornea, and microscopically by the examination of a conjunctival biopsy. Histologic studies established the presence of cystine crystals in the liver, kidneys, bone marrow, spleen, adrenal glands, and lymph nodes.

Microscopic examination of the right eye revealed cystine deposits in the conjunctiva, sclera, episclera, ciliary body, choroid, and extraocular muscles.

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## NOTICE OF ERROR

The name of George E. Shambaugh, Jr., M.D., should have appeared as co-author with Z. Z. Godlowski, M.D., of the article on "Hormones Related to Allergy," in the November-December 1958 issue of the TRANSACTIONS, pp. 835-863. We regret this omission.

TRANSACTIONS

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All communications regarding the TRANSACTIONS should be addressed to
William L. Benedict, M.D., LL.D., Executive Secretary-Treasurer
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# GROUP INSURANCE PROGRAMS

During the year 1952 the Academy under the guidance of its officers and Executive Council studied various programs of group insurance that could be made available to members of the Academy. On July 1, 1952, the first program of Group Insurance was conceived and made a reality for the members. Subsequently, the Academy's portfolio of group insurance has been broadened to include not only the Group Disability Income Protection Program, but the following programs as well:

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Major Hospital Insurance
Group Life Insurance and Retirement-Annuity

## GROUP DISABILITY INCOME PROTECTION (UNDERWRITING COMPANY—CONTINENTAL CASUALTY COMPANY)

This program of group insurance was made available to members of the Academy on July 1, 1952. It provides three plans of coverage in which the member may elect to participate. The first plan provides the insured member $50.00 weekly while he is disabled, the second plan provides $75.00 weekly, and the third plan $100.00 weekly. In addition to the income benefits there are benefits for partial disability, hospital confinement, accidental death, dismemberment and loss of eyesight, and polio and dread disease expense benefits. If the disability is due to sickness, benefits are payable from the first day of hospitalization or the eighth day of disability and may continue for as long as two years under the basic plan or for as long as five years under the extended plan. If disability is due to accident, income benefits are payable from the first day of disability and for as long as a lifetime in both the basic plan and the extended plan.

On July 1, 1954, the basic Academy program was broadened, because of good experience, to include an extended plan, which is mentioned above.

## ACCIDENTAL DEATH, DISMEMBERMENT AND LOSS OF EYESIGHT PROTECTION (UNDERWRITING COMPANY—EMPLOYERS MUTUAL CASUALTY COMPANY)

This program of insurance was made available to members of the Academy on

the first day of March 1956. It provides up to $200,000 of protection for accidental death, dismemberment and loss of eyesight.

On October 15, 1957, because of good experience, the Academy's program was broadened to make this coverage available to the spouse of the member.

On March 1, 1958, a reduction in premium was effected with this program. The original premium rate was $1.35 per $1,000 on the first $100,000 of coverage. The new rate schedule affords a premium of $1.25 per $1,000 for the first $100,000 of coverage. This rate reduction was made possible through good experience.

### PROFESSIONAL LIABILITY INSURANCE (UNDERWRITING COMPANY—EMPLOYERS MUTUAL CASUALTY COMPANY)

This insurance program was made available to members on March 1, 1956. It provides the member up to $300,000 of professional liability (malpractice) protection at minimum group premiums. On December 27, 1957, the Academy's professional liability insurance program was transferred to the Domestic Underwriting Company of Employers Mutual Casualty Company. This transfer made possible additional services to all members of the Academy and effected a reduction in the premium schedule.

### PROFESSIONAL OVERHEAD EXPENSE INSURANCE (UNDERWRITING COMPANY—AMERICAN CASUALTY COMPANY)

On November 1, 1957, a program of overhead expense insurance was made available to Academy members, providing up to $1,000 per month coverage. This program provides the insured member reimbursement of office expenses incurred while he is disabled and unable to perform his professional duties.

### MAJOR HOSPITAL INSURANCE (UNDERWRITING COMPANY—AMERICAN CASUALTY COMPANY)

This program of group insurance provides the member and his dependent family up to $15,000 of hospital expense coverage. There are three plans from which the member may choose: $100.00 deductible, $300.00 deductible, and $500.00 deductible.

This program of coverage was made effective for all acceptable applicants on November 1, 1958. If, however, 50 per cent of the eligible members apply for coverage under this program during the charter enrollment period, coverage will be issued to all appplicants regardless of medical history.

### GROUP LIFE INSURANCE AND GROUP RETIREMENT-ANNUITY INSURANCE (UNDERWRITING COMPANY—MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY)

In order that the Academy might offer a complete portfolio of insurance to its members, a program of group life insurance and group retirement annuity was made available to members of the Academy during the month of October 1958.

The group life program provides the member maximum coverage at attained age for a minimum annual deposit of $100.00. This coverage is continued to age 70. The retirement-annuity program makes available to the member a program whereby he can contribute any amount of monies (minimum $200.00 annually) for retirement income at age 65. This program provides a 10 per cent advantages in income benefits at age 65 if compared to a comparable plan purchased on an individual basis.

# In Memoriam

Howard H. Burnham.....Toronto, Ontario
November 16, 1958

Thomas H. Emmens.....Medford, Oregon
November 9, 1958

John P. Harbert.....Bellefontaine, Ohio
October 18, 1958

Theodore S. Kammerling.....Melrose Park, Illinois
November 20, 1958

Alfred Lewy.....Chicago, Illinois
December 14, 1958

William Wallace Reed.....Topeka, Kansas
December 22, 1958

Morton T. Siegel.....Covina, California
September 15, 1958

Ernest E. Tippin.....Wichita, Kansas
October 30, 1958

Henry Charles Weber.....Drexel Hill, Pennsylvania
October 30, 1958

# INTERNATIONAL ASSOCIATION OF SECRETARIES OF OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETIES

## The Spirit of Brussels

When Doctor Alan Woods stepped forward to receive the Gonin Medal at the International Congress of Ophthalmology in Brussels, his American contemporaries could not help but have a strong feeling of national pride, for when one of our great men does an outstanding job we all move up a little. Except for this, there was no concern with boundaries, either geographical or political. Everyone was engrossed in a united cooperative push toward solving the unknowns in medicine.

This goal can never be reached; this is fortunate, because these unknowns weld physicians together for cooperative action. At Brussels this cooperation created the electronic age in ophthalmology. It brought forth instruments for measuring the ocular diameter, the elevation of a retinal detachment, or the position of a foreign body by ultra sound; showing the results on an oscilloscope. Enormous perimeter-like machines recorded the electroretinogram for any part of the visual field. Ocular movements were measured by means of the eye's electrical potential differences.

Seeing all this, the thought is inescapable, or at least tempting, that if physicians are so effectively drawn together by their disease adversaries, surely the iron and bamboo curtains would vanish and everyone would become an ally of everyone else if only we were threatened by invasion from a hostile planet.

In the absence of such a planet the medical profession could supply global planners with plenty of spine-chilling unknowns toward which to direct a common front. Carcinoma and glaucoma are as dangerous as nuclear explosions and land mines. They are simply more widely dispersed and don't make as much noise.

This doesn't mean the world family must look very hard to find trouble. We have the atom bomb, but this is not a common danger because it is only the other fellow's bomb we worry about. Let the diplomats reveal disease as the much more powerful killer, show it in its horrible reality, supplant flash burn with sarcoma, then everyone will pull together.

Meanwhile, we had better study electronics.

J. V. D. Quereau, M.D.

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## Minutes of Annual Meeting, October 14, 1958

COUNCIL MEETING

The Council of the International Association of Secretaries of Ophthalmological and Otolaryngological Societies held a luncheon meeting on October 13, the day before the Annual Business Meeting. It was attended by President Dan S. DeStio, Editor Paul C. Craig, Executive Board Members A. E. Cruthirds, Willard F. Goff and Roderick MacDonald, Active Directors M. H. Barone, J. David Stratton, Moacyr Alvaro and H. B. Lockhart, and Secretary Edley H. Jones. Committee Chairman Peter N. Pastore was present as an invited guest.

The actions of the Council were presented to the Association at the Annual Meeting on October 14, and are included in the minutes of that meeting, with the following exceptions:

The Union of International Associations had invited this Association to be listed in their Year Book. This matter was tabled.

The Council authorized (1) $10.00 monthly for secretarial office expense, (2) a mailing service to mail reprints of this Association's news pages in the TRANSACTIONS of the American Academy of Ophthalmology and Otolaryngology to foreign secretaries who are not members of the Academy, and (3) a Seal for the Association.

The President had previously appointed a committee consisting of Drs. Peter N. Pastore, Chairman, F. E. Murdock and J. D. Stratton, to consider the proposal that Certificates of Membership be issued, and to make recommendations. The Committee recommended (1) that payment of dues be acknowledged by issuing billfold size membership cards, and (2) that a small certificate be made available for all secretaries who have been members of the Association for five years, and to all officers of the Association. By unanimous action, the recommendations were adopted.

## ANNUAL MEETING

The Annual Meeting of the Association was held in the Palmer House, Private Dining Room 18, at 5:30 p.m., Tuesday, October 14, 1958. It was a dinner meeting, the Association being the guests of the American Academy of Ophthalmology and Otolaryngology. The meeting was well attended, and as usual, all present registered and all present introduced themselves.

### *Message from the Academy*

After calling the meeting to order, President Dan DeStio called on Dr. Glen G. Gibson, Academy Secretary for Public Relations, for a message from the Academy. Dr. Gibson briefly discussed the instructional and program activities of the Academy, and requested the aid of the individual secretaries in making suggestions for good men to give Instructional Courses and to appear on the program.

Following Dr. Gibson's talk, President DeStio announced that the Council had authorized a standing committee for liaison with the Academy, and appointed Drs. Edley H. Jones and Rod MacDonald to serve on that committee. The Secretaries were requested to channel suggestions through this committee.

President DeStio then introduced Dr. Olga Ferrer of Havana, our only lady Secretary, and Dr. Yakimasa Nakaizumi, now taking a residency in California, representing his father, a Cooperative Director from Japan.

The President announced that Dr. Roland Myers, President-elect, was prevented from attending the meeting by illness and requested the Secretary to read a telegram from him. In this telegram Dr. Myers expressed his regret that illness prevented his presence, congratulated the Association on its progress, requested all Secretaries to continue their interested cooperation, and expressed his pleasure for this opportunity for service during the coming year.

Inasmuch as the Minutes had been distributed to each Secretary and had been printed in the TRANSACTIONS, it was moved, seconded and unanimously carried that the Minutes be approved as printed.

### *President's Report*

The President then gave his report, discussing problems and matters of interest to the Association. He commented

on the program activities of the various types of societies, suggesting better exchange of programs and ideas by Secretaries of similar societies. He expressed his pleasure at the international activities of the Association during the past year, stating that they would be discussed later by other members. He reported that the Council had recommended the preparation of a handbook for new society officers, reviewing and incorporating the suggestions that had been made by the members of this Association during the past years, and adding any additional indicated information and suggestions. He also reported that the Council had approved two standing committees, one for liaison with the Academy, which he had previously announced, and the other for liaison with international organizations. He appointed Dr. Moacyr Alvaro chairman of this latter committee, other members to be added later. He closed his report by thanking the Association for their cooperation during the past year.

*International Activities*

The President then called on Dr. Moacyr Alvaro for a report on international activities. Dr. Alvaro reported that he had attempted to obtain a seat on the International Council of Ophthalmology for this Association but had so far been unsuccessful. He reported that the International Council of Ophthalmology had listed two new groups, the Pan-American Association of Ophthalmology, and the International Association of Secretaries of Ophthalmological and Otolaryngological Societies. Dr. Alvaro's report was applauded vigorously.

Dr. Alvaro, speaking as the Executive Director of the Pan-American Association of Ophthalmology, invited this Association to appoint a representative to serve on the Board of the Pan-American Association. President DeStio thanked Dr. Alvaro in the name of the Association and announced that this appointment would be made at a later date.

*International Congress of Ophthalmology*

At the last Annual Meeting, Dr. A. E. Cruthirds was elected Delegate to the International Congress of Ophthalmology. The President called for his report. Dr. Cruthirds reported that the Congress had been a wonderful meeting, attended by more than 3300 ophthalmologists, of whom more than 400 were from the United States. He stated that they had an outstanding scientific program and a very excellent social program. The next meeting will be held in New Delhi, India, in 1962.

The President had appointed Drs. E. Filippi-Gabardi and A. E. Cruthirds as co-chairmen of a committee to arrange a cocktail party for members of this Association attending the International Congress. Dr. Gabardi had raised the sum of $150.00 for this purpose and the Association had authorized a sum not to exceed $400.00, that amount having been forwarded to Prof. Jules Francois, Secretary of the Congress, for deposit with the Hotel Metropole. Dr. Cruthirds reported that the party was quite successful, being attended by approximately 65 guests, including the President and Secretary of the Congress, and many other prominent ophthalmologists as well as many of our own Secretaries. He further reported that the Committee had stayed within the budget. (After the meeting, but before these minutes were printed, Dr. Francois returned $189.24 to the Association.)

The President complimented Drs. Filippi-Gabardi and Cruthirds on their handling the cocktail party so efficiently.

The Secretary then read a cablegram from Prof. Francois to the Association which read, "My best wishes for successful meeting."

*Asia-Pacific Academy of Ophthalmology*

The President then called on Dr. Cruthirds for a report on the Asia-Pacific Academy of Ophthalmology. Dr. Cruthirds stated that the organization meeting of this Academy was held during the International Congress of Ophthalmology and that the organization of the Academy could now be considered an accomplished fact. Dr. Geminiano de O'Campo of the Philippines was elected President and Dr. William John Holmes of Hawaii was elected Secretary-General. The first meeting of the Academy will be held in Manila in 1960. Dr. Cruthirds further reported that following the International Congress of Ophthalmology a group of ophthalmologists were returning home through the East and that Dr. Holmes had arranged a series of meetings where these men would give lectures.

Following Dr. Cruthirds' report, the Secretary reported that he had received a copy of the minutes and of the by-laws from Dr. William John Holmes; and a letter from Dr. Jesus Tamesis which included this information and also expressed his regret at being unable to attend this meeting of our Association.

The Association complimented Dr. Cruthirds for his outstanding work with this Academy by a rising vote of thanks.

Dr. Cruthirds moved that the Association compliment Drs. Holmes and Tamesis for their very excellent work in the formation of the APAO. The motion was seconded and unanimously carried.

*Handbook*

At this time the Council's recommendation that a handbook for new officers of our societies was again discussed. It was moved, seconded and unanimously carried that the Association appoint a committee to prepare such a handbook. President DeStio announced that he would later appoint this committee.

*Election of Officers*

President DeStio had previously appointed a nominating committee consisting of Drs. Paul C. Craig, chairman; Edley H. Jones and R. J. Viger. He now called on Dr. Craig for the Committee's report. The Committee nominated the following: President, Dr. Roland H. Myers; President-elect, Dr. M. H. Barone; Editor, Paul C. Craig; Secretary-Treasurer, J. David Stratton; Active Directors (for 3 years), Peter N. Pastore, Burton E. Lovesey, J. A. Dillahunt, John F. Tolan, Moacyr Alvaro; Cooperative Directors (for 3 years), Alejandro Salleras, Buenos Aires, Argentina; Guy Offret, Paris, France; C. C. Ring, Auckland, New Zealand; and Capt. R. Senn, Calcutta, India.

The President called for other nominations but none were made. It was moved, seconded and carried that the nominations be closed and the nominees were elected unanimously.

*Auditing Committee*

At the Council Meeting the previous day the President had appointed an Auditing Committee consisting of Drs. M. H. Barone, chairman; H. S. Lockhart and Paul C. Craig. They reported the books neatly kept and in order, and complimented the Secretary-Treasurer on the balance on hand.

*New Business*

Under the head of new business, Dr. Kenneth Craft reported that Dr. Bill Keith, a former President, is very seriously ill and suggested that the Executive Board consider electing him an Honorary Member. This was referred to the Executive Board. (The Executive Board held a meeting immediately following the Annual Meeting of the Association and elected Dr. Keith to Honorary Fellowship.)

The President then called on Dr. J. V. D. Quereau of Reading, Pennsylvania, who had headed a Committee on Public Relations for the Pennsylvania Academy of Ophthalmology and Otolaryngology. Dr. Quereau reported in detail on the work of his committee in Pennsylvania. Following his talk, Dr. Jones urged that Secretaries encourage ophthalmologists and otolaryngologists to take more interest in the economic and political side of our profession, and reported on the activities of the Mississippi Eye, Ear, Nose and Throat Association, which was organized to meet such problems, and has so far been successful.

The question as to whether or not this Association had any liaison with the National Medical Foundation for Eye Care was raised. The secretary reported that the Foundation had requested from him a roster, which had been forwarded them; and that the Secretary of the Foundation had been invited to join this Association.

Newly elected Secretary Dave Stratton discussed the matter of new ideas for better programs, suggesting that anyone with good ideas write him and that he would pass these ideas along.

There being no further business the meeting adjourned.

[Signed] EDLEY H. JONES, M.D.
*Secretary*

# BOOK REVIEWS

SPEECH RECOVERY AFTER TOTAL LARYNGECTOMY. By C. J. Hodson and M. V. O. Oswald. Edinburgh, E. S. Livingstone, 1958. 36 pp., illustrated. $1.50.

This little pamphlet presents the data obtained in more recent years by the use of roentgen ray cinematographic studies of movements taking place in different areas of the body in laryngectomized patients. Results of these studies have enabled speech therapists to approach the problem of vocal rehabilitation in a different and much more appropriate manner. Rehabilitation includes both the manner of speech production and improved quality of speech.

It is the reviewer's opinion that laryngologists, speech therapists and laryngectomees alike would derive much benefit from this excellent presentation during the short time required to read it.

J. C. L.

EYE SURGERY. By H. B. Stallard, M.D. Third Edition, Baltimore, Williams & Wilkins, 1958, 858 pp., 671 illustrations; index. $18.00.

The earlier editions of Stallard's Eye Surgery have earned the admiration of ophthalmic surgeons the world over, and they will eagerly accept this new edition, presenting as it does the newest and soundest surgical teaching extant. This third edition contains entirely new material that has become acceptable over the last few years. The descriptions of surgical procedures are clear and frequent illustrations are included where most needed. This is a complete modern text on eye surgery.

W. L. B.

APPLIED MEDICAL LIBRARY PRACTICE. By Thomas E. Keys, A.B., M.A., Librarian of the Mayo Clinic, Assistant Professor of History of Medicine, Mayo Foundation Graduate School, University of Minnesota. Springfield, Ill., Charles C Thomas, 1958. Cloth; 495 pp.; index. $10.75.

The medical library is the workshop of the teacher, the writer, student and practitioner. It is the storehouse of books, brochures, papers, pamphlets, reprints, journals, reviews, pictures and indexes of medical literature. The size of the library and the extent of its scope of service are proportional to its clientele, for a well staffed library is an expensive institution. We depend on the library for reference work in writing papers and for periodic reviews of topics of special interest. There we expect to find intact and classified the books and journals on basic science, medical history, bibliography, educational movements and many other subjects that one could not possibly maintain in his own private library. What a doctor should know about a medical library, the available services of the librarians, how medical literature is indexed, classified, shelved and preserved are explained in this book.

The librarian is instructed in matters of administration, the acquisition, cataloging and classification of medical literature. The chapters on medical indexes, abstract journals, reprints and hospital libraries for patients set forth a

working plan applicable to the average-size medical library.

More than one half of the book is given to the description of private medical libraries of distinguished authors, representative medical libraries in the United States, medical publishers and books, and a bibliography of medical works in facsimile. At the Mayo library the journal circulation of unbound issues comprises more than 200 titles.

Every medical library has its individual problems but there is available a nationwide service invaluable to writers and students and particularly busy doctors. The users of the library enjoy the fruits of medical bibliography in the various indexes available in the library catalogue. Its uses are numerous.

W. L. B

# News - - - Notes

### CHICAGO

The Chicago Ophthalmological Society will hold its annual clinical conference on February 13 and 14, 1959, at the Drake Hotel in Chicago.

The guest speakers will include Dr. Paul A. Chandler, Boston; Dr. Charles E. Iliff, Baltimore; Dr. Samuel J. Kimura, San Francisco; Dr. John Harry King, Washington, D. C.; Dr. J. Vernal Cassady, South Bend, Ind.; Dr. R. Charles Oldfield, Jr., Oak Park, Ill.; Dr. Frank Pirrucello, Evanston, Ill.; and Drs. J. Robert Fitzgerald, William F. Hughes, Gilbert Iser, Bertha Klein, Frank W. Newell, John H. Olwin, and Theodore Zekman, Chicago.

The subjects will include a symposium on the management of surgical conditions of lids and lacrimal apparatus, management of uveitis, prophylaxis and treatment of vascular occlusions, principles of plastic surgery, clinical value of electroretinography, management of cardiac arrest and glaucoma management, and present status of preserved eye tissue for transplantation.

Registration fee for the entire course including roundtable luncheons and buffet supper is $45.00, and is payable to the Registrar, Mrs. Edward J. Ryan, 1150 North Lorel Ave., Chicago 51.

The Fifteenth Annual Sanford R. Gifford Memorial Lecture will be delivered by Dr. Paul A. Chandler of Boston on Friday, February 13, 1959, at the Drake Hotel, at 5:15 p.m. All ophthalmologists are invited to attend the Gifford Memorial Lecture and the buffet supper which follows.

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### POSTGRADUATE COURSES

The Institute of Ophthalmology of the Americas, New York Eye and Ear Infirmary, will offer the following Postgraduate Courses:

1. Ocular Surgery, May 18-29, 1959. It will include Cataracts, Keratectomies and Keratoplasties, Pterygium, Lacrimal Sac, Retinal Detachment, Muscles (including Ptosis), Glaucoma, Enucleation and Evisceration, and Orbitotomy. Registration is limited. Preference will be given ophthalmologists taking the entire course. If places are available, doctors may register for individual parts.

2. Histopathology of the Eye, May 18-23, 1959. Limited Registration. For further information, please write Mrs. Tamar Weber, Registrar, Institute of Ophthalmology of the Americas, New York Eye and Ear Infirmary, 218 Second Ave., New York 3, N. Y.

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### SCHOLARSHIPS

The Central Office for Delta Gamma Fraternity, 1820 Northwest Blvd., Columbus 12, Ohio, has announced that it is now receiving applications for scholarships offered by the Delta Gamma Foundation for training of Orthoptic Technicians, teachers of partially seeing children, and specialists for blind children. The deadline is May 1.

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### INSTITUTE BARRAQUER

A course for postgraduates in ophthalmology is being offered by the Institute Barraquer, Laforja, 88, Barcelona, Spain, during the period from November 1958 to July 1960.

Clinical sessions will be held from 8:00 to 4:00 o'clock on Mondays, Wednesdays and Fridays. Students will be required to take part in functional explorations including refraction, campimetry, ocular motility, and binocular vision, and to engage in objective explorations such as biomicroscopy, gonioscopy, ophthalmoscopy and tonography. Orthoptic and pleoptic sessions will be held.

On alternate days surgical sessions will convene.

The ophthalmic seminar will comprise three evening lectures each week. A sys-

tematic revision of ophthalmology will be considered. In addition there will be lectures with discussions and presentations of clinical cases of the subject under consideration.

The purpose of this course is to ensure a better training program for the accepted candidates. The number of candidates will be limited. Applicants will be selected on the grounds of merit, subject to the approval of the Rectorial Board of the Institute.

The applicants should have the following minimum qualifications: title of a licentiale in medicine and surgery, or the equivalent foreign degree. Applicants who have had one year's practice in the specialty at a clinic or an institute of recognized scientific standing will receive preference.

Professor Dr. Ignacio Barraquer will be rector of the course. The faculty will include Dr. Joaquin Barraquer, Dr. Pascual Gonzalez-Marin, Dr. Alfredo Muinos Simon, Dr. Joaquin Rutllan, and Dr. Jose Maria Simon Tor.

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## OXFORD OPHTHALMOLOGICAL CONGRESS

Mr. Ian C. Fraser, Secretary of the Oxford Ophthalmological Congress, has announced that the Congress will celebrate the Fiftieth Anniversary of its Foundation at the annual meeting to be held July 1 through 4, 1959, at the University Laboratories of Physiology, South Parks Road, Oxford.

The main discussion will deal with "Ophthalmic Manifestations in Paediatric Practice." One day will be devoted to "After Thoughts" on the Doyne Lecture delivered by each of the fifteen past lecturers.

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## SIXTH PAN AMERICAN CONGRESS OF OPHTHALOMOGY VENEZUELA, 1960

Plans are going forward rapidly for the Sixth Pan American Congress of Ophthalmology, which will be held in Caracas, Venezuela, January 31 to February 7, 1960.

The organizing committee for the Congress, of which Dr. Jesus Rhode of Caracas is Executive President, has announced that the Venezuelan government and the citizens of Caracas are looking forward to receiving visiting ophthalmologists in their ultramodern city. Caracas is located in a beautiful valley at an altitude of 3,000 feet, surrounded by mountains, yet only twenty minutes away from the sea.

Headquarters of the Congress will be the Hotel Tamanaco, and there are many other splendid hotels. Rates for accommodations are approximately the same as those for comparable hotels in the United States; for example, the Palmer House in Chicago or the Waldorf-Astoria in New York. A list with rates expressed in United States dollars is appended. Provision is being made for less elaborate quarters for those who prefer them. A large attendance is expected, and ophthalmologists are urged to make reservations early.

The scientific program will consist of round table discussions, symposia, free papers, motion pictures, scientific and technical exhibits. Subjects announced for the symposia are: Virus Diseases of the Eye, Toxoplasmosis, Genetics, Retinal Detachment, Advances in Ocular Therapeutics, Advances in Ocular Surgery, and Strabismus. The panel discussions will cover Therapeutics of Infectious Diseases, Surgical Techniques in Strabismus, Surgery of Cataract, Recent Advances in Treatment of Glaucoma, and Space Ophthalmology.

Those who are to participate in the program are urged to send titles and short abstracts of papers and applications for the showing of new films and exhibits before May 1, 1959, to Dr. James H. Allen, New Orleans, chairman of the program committee for North America. Ophthalmologists north of Panama wishing to participate may write to Dr. Allen at Tulane University School of Medicine, 1430 Tulane Avenue, New Orleans 12.

A social program typical of Latin American hospitality is being arranged by the ophthalmologists of Caracas, with unusual official entertainments and many private parties to which visiting eye physicians will be invited.

For detailed information about arrangements, ophthalmologists should write to Dr. Jesus Rhode, the Executive President, or Dr. Hernandez Miliani,

Comite Ejecutivo, Apartado 5666, Chacao, Caracas. Dr. William L. Benedict, 15 Second Street S.W., Rochester, Minn., is in charge of plans for transportation. Further information may be obtained by writing to the Secretary-Treasurer for North America, Dr. J. W. McKinney, 921 Exchange Building, Memphis, Tenn.

Dr. Brittain F. Payne, New York, is President of the Pan American Association of Ophthalmology, and Dr. Moacyr E. Alvaro, Sao Paulo, Brazil, is Executive Director.

Following is the list of hotels:

| | Single | Double |
|---|---|---|
| Avila | $10-13 | $18 |
| Tamanaco | 13 | 16 |
| El Conde | 9-12 | 12-15 |
| Potomac | 15 | 27 |
| Ambassador | 6 | 9 |
| Nacional | 6.50 | 9.50 |
| Klindt | 5 | 9 |
| Savoy | 5-7 | |
| Cumera | 10 | |
| Astor | 18 | 19 per suite of 4-5 rooms |

FRANK H. CONSTANTINE, M.D.
Asst. Secretary, Public Relations

## POSITIONS AVAILABLE

ASSOCIATE OPHTHALMOLOGIST wanted to assume responsibilty of second office in new contemporary building. Opportunity for teaching or research. Office fully staffed and equipped. Active surgery. No investment needed. Remuneration open. For further information write to Malcolm A. McCannel, M. D., Doctors Building, Minneapolis 2.

Listings of positions available should be sent to W. L. Benedict, M.D., 15 Second Street S. W., Rochester, Minn., by the fifth of the month preceding publication. They should include (1) type of physician wanted (ophthalmologist or otolaryngologist: diplomate, resident, etc.) (2) type of position to be filled; and (3) whom to write for further information. Unless otherwise requested, listings will be published only once.

The Academy will handle no further correspondence beyond the listing and assume no responsibility. Neither does it endorse nor guarantee any of the published listings.

## FOREIGN SUBSCRIPTIONS

Some foreign members of the Academy as well as subscribers to the TRANSACTIONS are experiencing difficulty in remitting in American dollars. For their convenience the Academy will accept any legal foreign currency in payment of dues, fees for Home Study Courses, Teachers' Manuals, Orthoptic Journals, TRANSACTIONS, etc., at the prevailing rate of currency exchange.

## HAVE YOU CHANGED YOUR ADDRESS?

To ensure uninterrupted delivery of your TRANSACTIONS, please return this coupon or send the same information on a post card to

American Academy of Ophthalmology and Otolaryngology
15 Second St. S.W., Rochester, Minnesota

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PLEASE PRINT

| FORMER ADDRESS: | NEW ADDRESS: |
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| Street..... | Street..... |
| City..... | City..... |
| Zone.....State..... | Zone.....State..... |

For countries outside the United States:

.....

NAME OF COUNTRY

# TEACHING AIDS

## MANUALS

| | PRICE |
|---|---|
| RETINAL DETACHMENT, H. Arruga, et al. | $1.00 |
| OCULAR SURGERY, Conrad Berens and J. H. King | 1.00 |
| CATARACT TYPES, F. C. Cordes | 1.00 |
| SLIT LAMP BIOMICROSCOPY, E. Goar, et al. | 1.00 |
| DESCRIPTION OF THE ORBIT, McCotter, Fralick and Henderson | 1.00 |
| GLAUCOMA, Samuel J. Meyer | 1.00 |
| THE INTERPRETATION OF VISUAL FIELDS, C. W. Rucker | 1.00 |
| REFRACTION, Daniel Snydacker and Frank W. Newell | 1.00 |
| EXTRINSIC EYE MUSCLES, H. Saul Sugar | 1.00 |
| MICROBIOLOGY OF THE EYE, Ted Suie | 1.00 |
| PRINCIPLES OF OTOLARYNGOLOGIC PLASTIC SURGERY, Oscar Becker | 1.00 |
| EMBRYOLOGY OF THE HEAD AND NECK IN RELATION TO THE PRACTICE OF OTOLARYNGOLOGY, Jack Davies | 1.00 |
| RADIOGRAPHIC ANATOMY OF THE TEMPORAL BONE, J. Brown Farrior | 1.00 |
| EXAMINATION OF THE LABYRINTH IN RELATION TO ITS PHYSIOLOGY AND NONSUPPURATIVE DISEASES, W. J. McNally and E. A. Stuart | 1.00 |
| NONSURGICAL COMPLICATIONS OF OTOLARYNGOLOGIC SURGERY, J. J. Pressman, et al. | 1.00 |

## MONOGRAPHS

| | |
|---|---|
| HELPFUL HINTS FOR HANDLING THE HEARING HANDICAPPED, Gordon D. Hoople, et al. | $0.25 |
| HEARING TESTS, Arthur L. Juers | 0.25 |
| PHYSIOLOGY OF THE LARYNX, J. J. Pressman and George Kelemen | .50 |
| THE EMBRYOLOGY OF THE EAR, NOSE, AND THROAT, O. E. Van Alyea | 0.25 |
| STRABISMUS: A SYMPOSIUM, Kenneth C. Swan, et al. | 0.50 |
| REFRACTION DIFFICULTIES Clarence A. Veasey, Jr. | 0.50 |

## ABSTRACTS

Set contains outlines, briefs of instruction courses as presented at Academy meetings. Unbound.

| | | |
|---|---|---|
| Ophthalmology: | 1957 | $5.00 |
| | 1958 | 8.00 |
| Otolaryngology: | 1957 | 2.00 |
| | 1958 | 8.00 |

## TRANSACTIONS

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